MAY 26 1924

Printed on Thin Paper for Foreign Circulation.
"THE ENGINEER," MAY 16, 1924.

BRITISH EMPIRE EXHIBITION NUMBER—No. 4.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXVII.—No. 3568] LONDON: FRIDAY EVENING, MAY 16, 1924 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lam[b]eth, S.E. 1, REQUIRES—
WHEELS and AXLES.
Tenders due on the 27th May, 1924.
Tender forms obtainable from above. 5776

Architectural Draughts-MEN REQUIRED for temporary employment in Government Departments. Candidates must have served in H.M. Forces during the war, have had good training in Civil Engineers' or Architects' Offices, and be fully capable of Preparing Working Drawings and Specifications for General Civil Engineering or Architectural Work. Salary, according to qualifications, but not exceeding £275 per annum.—Written applications, with full details of experience and qualifications, should be addressed to the JOINT SUBSTITUTION BOARD (Treasury and Ministry of Labour), Montagu House, Whitehall, S.W. 1. Replies will be sent only to such candidates as appear prima facie suitable for interview. 5765

Civil Engineer Required by the GOVERNMENT of CEYLON for three years' service as District Engineers in the PUBLIC WORKS DEPARTMENT. Salary £500, rising to £900 a year. Free passages. Candidates, age between 25 and 35, preferably unmarried, should have passed the examination for Associate Membership of the Institution of Civil Engineers, and have had experience as a Contractors' Engineer on Public Works or as an Engineer in charge of work carried out departmentally. Must be competent in surveying (engineering) and levelling.—Apply at once in writing, giving age, qualifications and brief details of experience, and stating whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/12,740. 5725

Engineers Required for the Public Works Department, Tanganyika Territory, for a tour of not less than twenty nor more than thirty months' service. Salary £600 a year, paid in local currency, plus a strictly temporary local allowance of £100, at present authorised up to the 31st December, 1924, after which date its continuance or otherwise will be subject to review. Free quarters and passages and liberal leave on full salary. Candidates, preferably unmarried, aged 28 to 35, must be trained Civil Engineers, with experience on Location and Construction of Colonial Roads.
Apply at once by letter, stating age, and giving brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/12,785. 5764

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that SIDNEY LEOPOLD PRICE, British Subject, of 185, King's-avenue, Clapham Park, London, S.W.12, late of 62, Eagle-street, Holborn, W.C. 1, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 200,850, granted to him for "Improvements in Incandescent Electric Lamps."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) issued on the 7th May, 1924.
Any person or persons may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. TEMPLE FRANKS,
5730 Comptroller-General.

"Norton and Gregory Engineering Scholarships, 1924."
The following Scholarships, total value £450, have now been awarded:—
DOUGLAS JAMES THOMAS HAYNES, Charterhouse School, Godalming: £80 per annum, tenable for 3 years at Cambridge University.
JOHN PHILLIP BERRIS, Taunton School: £50 per annum, tenable for 3 years at Cambridge University.
THOMAS BLENCH, Allan Glen's School, Glasgow: £30 per annum, tenable for 3 years at Glasgow University. 5746

University of Sheffield.
COURSES IN MECHANICAL ENGINEERING.
Professor F. C. LEA, D.Sc., M. Inst. C.E., M.I.Mech.E. Professor of Mechanical Engineering.
DEGREE, ASSOCIATESHIP and WORKS PUPILS' COURSES.
Applications are also invited from those desiring to do Research Work in Engineering.
Full particulars may be obtained from Professor Lea, Department of Applied Science, St. George's-square, Sheffield.
W. M. GIBBONS,
5580 Registrar.

Administrative County of LONDON.
The London County Council will REQUIRE in September next an INSTRUCTOR in STRUCTURAL STEELWORK at the L.C.C. School of Building, Ferndale-road, Brixton, S.W. 4, for one evening attendance of about three hours weekly at a fee of 22s. an attendance. Practical knowledge of the Design and Erection of all Classes of Structural Steelwork in Buildings necessary.
Preference given to candidates who have served or attempted to serve with H.M. Forces.
Apply, Education Officer (T.1.a.), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary) for form, to be returned by 28th May, 1924. Canvassing disqualifies.
JAMES BIRD,
5755 Clerk of the London County Council.

The University of Manchester.
APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in ENGINEERING. Stipend, £300 per annum.
Candidates should have some Civil Engineering Experience and be able to give assistance in the Surveying Field Courses.
Applications should be sent to the INTERNAL REGISTRAR not later than 21st June. Further particulars may be obtained on application to the Internal Registrar. 5625

PUBLIC NOTICES

Applications are Invited for the POST of WORKSHOP SUPERINTENDENT in the GOVERNMENT TECHNICAL INSTITUTE, INSEIN, BURMA.
Three years' agreement in first instance. Salary at rate of Rs. 600-50-1000 per mensem. Free house. Free passage to Burma and return passage at end of agreement.
Candidates, preferably between 25 and 35 years of age, should have been trained as a Millwright Foreman and should possess experience in teaching practical work. Experience in the Running of Steam and Internal Combustion Engines also required.
Further particulars may be obtained from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1, by whom detailed applications will be received not later than 31st May, 1924. 5777

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for:—
(A) STEEL TYRES.
(B) AXLE-BOX FACE-PLATES.
Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 12th May, 1924.
A fee of 20s. will be charged for Specification (A), and 10s. for (B), which are not returnable.
Tenders must be submitted not later than Noon on Tuesday, 27th May, 1924.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the orders.
By Order of the Board,
R. C. VOLKERS,
5738 Secretary.

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.
The Directors are prepared to receive up to Noon on Wednesday, 28th May, TENDERS for the SUPPLY of:—
(1) METALS.
(2) MATERIALS for STEEL FOUNDRY.
(3) WOOD SCREWS, NAILS, SPLIT PINS, &c.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for No. 1 and 10s. each for Nos. 2 and 3 (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
G. S. YOUNG,
Secretary.
Offices: 91, Petty France, Westminster, S.W. 1.
12.5.'24. 5741

Borough of Hemel Hempsted.
STEAM ROLLER.
TENDERS are INVITED for the SUPPLY of a new 10-Ton STEAM ROLLER, fitted with Morrison Scarifier.
Form of Tender may be obtained from the undersigned and must be delivered not later than the 29th inst.
The Corporation does not bind itself to accept the lowest or any Tender.
WALTER R. LOCKE,
Borough Surveyor.
Hemel Hempsted,
8th May, 1924. 5739

PUBLIC NOTICES

Metropolitan Water Board.
MAIN, KEMPTON TO CRICKLEWOOD.
TENDERS FOR SECTION NO. 2.
LAYING 48in. CAST IRON MAIN AND CONTINGENT WORKS FROM GREENFORD TO CRICKLEWOOD AND THE LAYING OF 27in. CAST IRON PIPES FROM NEAR HANGER-LANE TO EALING.
The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of about 8445 YARDS of 48in. diameter CAST IRON WATER MAIN, principally through fields, and also the LAYING of about 1650 YARDS of 27in. STEEL PIPES, mainly in subways, from Windmill-lane, north of the Board's existing Valve House, in the Parish of Greenford, to the Board's Works at Cricklewood, in the Parish of Willesden, together with about 1447 YARDS of 27in. diameter CAST IRON MAIN, branching from the 48in. diameter main near Hanger-lane, in the Parish of Wembley, and extending to the neighbourhood of the Board's Fox Reservoir, in the Parish of Ealing, all in the County of Middlesex.
Drawings, conditions of contract and specifications may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 201), on and after 14th May, 1924.
Form of Tender, conditions of contract, specification, bills of quantities and schedules of prices, together with drawings and a spare copy of the bills of quantities and schedules of prices, may be obtained on and after 19th May, 1924, from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £20, which sum must be deposited with the Accountant to the Board, and will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities and schedules of prices, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board" and not to individuals.
Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, Clerkenwell, E.C. 1," and endorsed "Tender for Main, Kempton to Cricklewood, Section No. 2," must be delivered at the Offices of the Board (Room 123) not later than 10 a.m. on Thursday, 5th June, 1924.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board:
New River Head,
Clerkenwell, E.C. 1,
6th May, 1924. 5703

Tenders for the Purchase of COPPER AND BRONZE WIRE, STAY RODS AND SPINDLES FOR THE POST OFFICE TELEGRAPH AND TELEPHONE SERVICE.
BY COMMAND OF THE POSTMASTER-GENERAL, IRISH FREE STATE.
TENDERS will be RECEIVED up to Noon on the 25th June, 1924, for the following:—
50 Tons COPPER WIRE, Hard Drawn.
7 Tons BRONZE WIRE.
3600 STAY RODS.
25,000 SPINDLES.
Forms of Tender and schedule may be obtained from the undersigned.
M. DALTON, Controller of Stores.
Stores Department, G.P.O.,
Aldborough House, Dublin. 5720
G6223 W.H.Co.

PUBLIC NOTICES

City of Liverpool.
TRAMWAY MATERIAL.
The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of various classes of TRAMWAY MATERIAL, as under:—
Schedule No. 1.—Steel Tramway Rails and Fish-plates.
Schedule No. 2.—Steel Fish-bolts.
Schedule No. 3.—Steel Tie-bars.
Schedule No. 4.—Copper Bonds.
Firms are required to state clearly, when making application for the necessary Tender forms, the name and number of the schedule for which they desire to be furnished with Tender form.
Duplicate forms of Tender for record purposes will NOT be supplied.
Tender forms will be forwarded UPON RECEIPT OF APPLICATION IN WRITING to:—
The City Engineer,
Municipal Buildings, Dale-street,
Liverpool.
Tenders must be sealed and enclosed in the official envelopes provided, endorsed in accordance with the instructions given on the form of Tender, and FORWARDED THROUGH THE POST, addressed to:—
"The Town Clerk, Municipal Buildings, Liverpool."
LATEST TIME AND DATE FOR RECEIPT OF TENDERS:—
TEN O'CLOCK A.M. ON FRIDAY, THE 23RD MAY, 1924.
WALTER MOON,
Town Clerk.
1st May, 1924. 5662

Great Southern and Western RAILWAY (IRELAND).
CONTRACTS, 1924.
The Directors of the Great Southern and Western Railway Company are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES for six months commencing 1st July, 1924.

	No. of Form.
Acid, Sulphuric	5D
Asbestos Sheeting, &c.	40
Baskets	10
Bolts, Nuts, and Rivets	15
Brooms and Brushes	13
Brass Fittings for Carriages	18
Do do. for Water	26A
Do. do. for Gas	24B
Canvas and Sacks	6
Canvas for Wagon Tarpaulins	6A
Castings, Mall. Iron	11
Carriage Laces	7A
Cloth for Carriages	7C
Clothing, I.R. proofed	9B
Coach Screws and Washers	15
Colours	2
Corks	30
Cotton Waste	5A
Crucibles	41
Drysalteries	3
Emery and Glass Cloth, &c.	26
Files and Tool Steel	20
Fire Bricks and Clay	33
Foundry Requisites	42
Galvanised Sheets, Buckets, &c.	23
Grates, Stoves	24
Grindstones	28
Glass, Sheet, and Plate	27A
Glass and China Sundries	27B
Hardware (Sundry)	17
India Rubber Goods	9A
Implements, Sundry	31
Iron Tubes and Fittings	29
Leather and Leather Goods	12
Locks and Keys	19
Mantles for Gas	24C
Mats, Fibre	10
Nails	31
Nuts, Hex., Black and Bright	15A
Packings	40
Plumbago	41
Railway Fastenings	16
Rain Water Pipes and Gutters	25
Ropes, Twine, and Flax	4
Soaps	5C
Sewer Pipes, Plaster of Paris, &c.	32
Shovels, Spades, &c.	21A
Sponge Cloths	5
Signal Wire Pulleys	11
Screws and Split Pins	14
Tin-plates	22
Waste	5A
Waterproof Clothing	9B
Wicks	5
Wire, Fence, and Signal	30A
Wirework	30B

Forms of Tender can be obtained on payment of 6d. each from the Stores Superintendent, General Stores Department, G.S. and W.R., Inchicore, Dublin. Applications for forms by post must be accompanied by postal order. Stamps cannot be accepted. All inquiries for information should be also directed to the Stores Superintendent.
Patterns may be inspected at the General Stores Department on and after the 19th inst., between the hours of 10 a.m. and 4 p.m. (except on Saturdays).
Tenders must be enclosed in the special envelope supplied for the purpose with each schedule, and must be posted so as to be with the undersigned before 10 a.m. on Wednesday, 4th June, 1924.
The Directors will not consider any Tender unless it is furnished on the Company's form, and do not bind themselves to accept the lowest or any Tender.
By Order,
C. E. RILEY, Secretary.
Kingsbridge Terminus, Dublin, May, 1924. 5757

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"THE ENGINEER" WANTED.

WANTED, VOLUMES of "THE ENGINEER" from July, 1914, to December, 1921; must be clean and complete.—Write, stating lowest price, P1000, The Engineer Office. P1000

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SITUATIONS WANTED, Pages 2 and 3
PATENTS, Page 3.
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MACHINERY, &c., WANTED Page 4.
FOR SALE, Pages 4 and 101.
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AGENCIES, Page 3.
MISCELLANEOUS, Page 2.

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PUBLIC NOTICES

Port of Bristol.

NEW ELECTRIC CRANES, BRISTOL CITY DOCKS.

The Docks Committee are prepared to receive TENDERS for the CONSTRUCTION of THREE 2-Ton MOVABLE ELECTRIC JIB CRANES, and the ERECTION of the same on the roof of Shed "U" (now in course of reconstruction), Canon's Marsh, Bristol City Docks.

On and after Tuesday, the 13th day of May, 1924, copies of the general conditions, specification, schedule of prices and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid to the Bristol Docks Committee (to whom all cheques must be made payable), 19, Queen-square, Bristol. The deposit of £5 will be returned hereafter to all bona fide tenderers.

Tenders must be enclosed in a sealed envelope endorsed "Tender for Three Electric Cranes," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 9th day of June, 1924.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Engineer, Port of Bristol

Chief Engineer's Office,
Avonmouth Docks,
9th May, 1924. 5475

Salford Union.

UNION INFIRMARY, PENDLETON, NEAR MANCHESTER.

RE-ADVERTISED, DUE TO DEATH OF CONTRACTOR'S PRINCIPAL.

The Salford Board of Guardians invite TENDERS for HEATING and HOT WATER SERVICE APPARATUS, including Calorifiers, Pumps, Mains, Radiators, and the like, for above Infirmary and Nurses' Homes Extension.

Drawings of the plant may be inspected at the offices of the Engineer, Mr. F. Roland Wollaston, M.I.M.E., Lord's Chambers, 26, Corporation-street, Manchester, on or after May 12th, between the hours of 10 a.m. and 4 p.m. Specification, schedule of quantities, form of Tender and conditions of contract, may be obtained from the undersigned on receipt of written application, enclosing cheque value Two Guineas, which sum will be refunded on due receipt of bona fide Tender.

The Board do not bind themselves to accept the lowest or any Tender. The selected contractor will be required to subscribe to the conditions as regards employment of labour, &c., as set forth in the Board's regulations.

Sealed Tenders, endorsed "Engineering Section 2," must be delivered at my office not later than 10 a.m. on Saturday, June 14th, 1924.

By Order,
E. H. INCHLEY,
Clerk to the Guardians.

Poor Law Offices,
Bexley Road, Salford,
13th May, 1924. 5769

City of Chichester.

WATERWORKS PUMPING STATION.

The Corporation REQUIRE a SECOND ENGINEER and MECHANIC at the above works. Wages, £2 5s. per week, with house and coal.

Applications, in own handwriting, stating age, with full particulars of experience (Suction Gas and Steam Engines, and General Repairs), and copies of testimonials, to be sent to the undersigned by Saturday, the 31st May next. Canvassing will disqualify.

(Sgd.) FRANK J. LOBLEY,
A.M. Inst. C.E.,
City and Water Engineer.

[Chichester, 12th May, 1924. 5759

City of Sheffield.

WATER DEPARTMENT.

APPOINTMENT OF ASSISTANT WATER ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT WATER ENGINEER.

Candidates must be properly qualified Engineers, and have had practical experience in the Distribution of Water, the Maintenance of Impounding Reservoirs and Works, Distributary Pipes, the Detection and Prevention of Waste, and the control of workmen. Preference will be given to Associate Members of the Institution of Civil Engineers.

Salary, £350 to £400 per annum.

Candidates will be required to devote the whole of their time to the service of the Corporation.

Applications, stating age, qualifications and experience, accompanied by copies of three recent testimonials, endorsed "Assistant Water Engineer," to be sent to me not later than Thursday, 29th May, 1924.

WILLIAM TERREY,
General Manager.

Town Hall, Sheffield,
13th May, 1924. 5770

Western Australia.

APPLICATIONS are INVITED for the POSITION of ENGINEER-IN-CHIEF of the PUBLIC WORKS DEPARTMENT of the Western Australian Government. The position is a permanent one under the Public Service Act. The successful applicant will be responsible for the Control of all Engineering Matters, including Design and Construction. Public Works comprise Water Supply, Drainage, Irrigation, Harbours, Roads, Bridges and Construction of New Railways. Commencing salary, £1500 per annum, rising to £2000 by annual increments of £100. Transport allowance, £280 for married man, £100 for single man. Should the successful applicant voluntarily relinquish the position before the expiration of two years from the date of his appointment, he will be called upon to refund the amount of Transport Allowance.

Applicants should state age and whether married or single.

Applications, which should be endorsed "Engineer-in-Chief," must reach the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, Strand, London, W.C. 2, on or before 7th June, 1924. 5760

SITUATIONS OPEN

WANTED by an Old-established Firm, a Capable ENGINEER, with thorough knowledge of the latest methods of Construction of Bituminous and Asphalt Roads. He would have to organise and be fully responsible for this department, including the Mixing Plants, Preparation of Road Surfaces and Laying the Material. Good salary and prospects for suitable man.—Address, stating experience and salary required, P9092, The Engineer Office. P9092 A

APPLICATIONS are INVITED for the POST of WORKS ENGINEER by Southall Bros. and Barclay, Ltd., for their Surgical Dressings branch at Charford Mills, Saltley, Birmingham.

Experience in handling labour and good organising qualities necessary. Wages £5 10s. weekly for the first year, also house, coal and gas.

Applicants should be 30-35 years of age.

Please apply by letter in confidence, and with full particulars of present position, to MANAGING DIRECTOR. P9098 A

CHEMIST, with Exp. Oil Seed Crushing and Refining, REQD. for Egypt. Aged 25/30, single.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 5749 A

CHIEF ENGINEER, Age 35/45 Years, for an Oil-crushing Mill in Alexandria, Egypt; must have expert knowledge of all departments, able to Take Full Charge and Control Labour. Thorough knowledge of Electrical Machinery absolutely necessary. State full particulars and salary required.—Write to "D. D.," c.o. Streets, 6, Gracechurch-street, E.C. 3. 5743 A

OIL CRUSHING MILL ENGINEER REQD. for Egypt. Prev. similar exp. essl., also Electrical Works. Aged 35/40.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 5748 A

AUCTIONS

IMPORTANT SALE BY AUCTION IN ONE LOT OF

THE TRADE NAME, GOODWILL, AND WORKS EQUIPMENT

OF

MESSRS. COCHRANE AND CO. (WOODSIDE), LTD., DUDLEY,

ENGINEERS, CAST IRON PIPE AND GENERAL IRONFOUNDERS, PIG IRON SMELTERS, AND OWNERS OF

IRONSTONE MINES (FREEHOLD AND LEASEHOLD) IN OXFORDSHIRE.

ESTABLISHED IN 1840, AND KNOWN IN ALL THE MARKETS OF THE WORLD.

Mr. Duncan J. Shedden, F.A.I.,

is instructed by Messrs. COCHRANE and CO. (WOODSIDE), Ltd., DUDLEY, to OFFER FOR SALE by PUBLIC AUCTION, in one Lot, as set out below, if not previously disposed of by private treaty, subject to conditions of sale, at

THE GRAND HOTEL, BIRMINGHAM,

On THURSDAY, JUNE 19, 1924, AT 2.30 p.m. PUNCTUALLY,

THE WHOLE CONCERN,

comprising

Abt. 1r. 15p. FREEHOLD SURFACE LANDS AT WOODSIDE,

with the VALUABLE MINES and MINERALS under, 24a. 2r. 6p., comprising the usual South Staffs. Measures of Brooch, Thick Coal, Heathen and Gubbin Ironstone, all of which are unworked save the Thick Coal, which has, it is believed, been worked over once prior to 1835, together with the extensive and SUBSTANTIALLY-BUILT WORKS SHOPPING AND ERECTIONS,

brick built, with slated roofs. STABLING for 50 horses, with Chaff and Feeder Rooms; WAGON GARAGES and LOCO. SHEDS. A Suite of ELABORATELY FITTED OFFICES, suitable and conveniently arranged for a large staff. A SIX-ROOMED DWELLING-HOUSE, No. 222, PEDMORE-ROAD.

The WORKS are conveniently situated for Transport, with long frontages to the Pensnett Canal and to the Dudley Branch of the Birmingham Canal, with the benefit of a special agreement for carrying material thereon, and connected by Sidings with the Main G.W. Railway Line at Round Oak and Woodside, and within the Works' boundaries are some 12,500 YARDS of PERMANENT WAY, and 2ft. 8½in. GAUGE RAILWAYS.

THE BLAST-FURNACE PLANT,

comprising TWO MODERN BLAST-FURNACES, 65ft. high by 16ft. dia. at the bosh, with steam-driven Hoist; Four Cowper Stoves, each 21ft. dia. by 54ft. to 57ft. high; Four Slack-fired Gyers' Calcining Kilns, capable of dealing with 1500 tons of ore weekly; a Hornbeam type Condensing Blast Engine, 53½in. cyl. by 10ft. stroke, with 8ft. 6in. Blowing Cylinder, housed in massively built Engine-house, 62ft. by 22ft. by 66ft. high, with C.I. Tank Roof, 5ft. deep; an auxiliary Blowing Plant, separately housed; the Steam-raising Plant, consisting of Five Lancashire Boilers, 8ft. 6in. dia. by 30ft. long, and Six Egg-ended Boilers up to 33ft. long, all in brick seatings and fired direct with Gas from the Blast-furnaces; the Steam Feed and Blow-off Pipes and system of Pumps; the Blast, Gas, and Water Cooling Mains; Two practically new Worthington Simpson Centrifugal Pumps, each 56,000 gallons per hour capacity, driven by Two 25 B.H.P. D.C. Shunt-wound Motors and connections; the Coke and Ore Bunkers and Gantries and C.I. Floors.

One Furnace is newly lined and ready to blow in, and No. 4 Stove is practically new; AN OUTPUT OF 650 to 700 TONS WEEKLY FROM EITHER FURNACE HAS BEEN AVERAGED FOR LONG PERIODS, AND THE FURNACES HAVE BEEN RUN FOR MONTHS ON A SELF-FLUXING BURDEN.

THE CAST IRON PIPE AND GENERAL FOUNDRY PLANTS,

capable of an output of 30,000 tons per annum, working on a single shift, comprises ELEVEN VERTICAL PIPE CASTING PITS FOR C.I. PIPES, 3in. to 48in. dia., in massive buildings, with gas-heated Core and Socket Drying Stoves; Four 2-Motor Cranes, to lift 2½ to 4 tons, and Nineteen 1-Motor Cranes to lift from 2½ tons to 20 tons.

THREE LARGE CASTINGS FOUNDRIES, SUITABLE FOR CASTINGS UP TO 10 TONS, with Four 10-ton steam-driven Cranes and Twelve Hand Cranes, with a 3 and 2-ton Hand Travelling Crane; GREEN SAND FOUNDRIES for C.I. Pipes, 11in. and upwards. There is a 5-ton Steam Loco. Travelling Crane, 4ft. 8½in. gauge, for loading purposes and removing boxes, &c.

A BATTERY OF SIX DUFF GAS PRODUCERS,

Five 10ft. dia. and One 8ft. dia. by 10ft. high, with Hydraulic Lifts, Cages, and Platforms, and C.I. flue connections. Foundries, Pipe Pits, and Stoves.

TANK CUPOLAS, EACH OF AN AVERAGE CAPACITY OF 4½ TONS PER HOUR,

with C.I. connections to a 200 H.P. Pontifex Scavenger Gas Engine, coupled to a 54in. Blowing Cylinder erected in Power-house; a CORE BAR MAKING SHOP, with a 6-ton Hand Travelling Crane;

A BELT-DRIVING BORING MILL FOR PIPES UP TO 12in. DIA.

Eleven HYDRAULIC PROVING PUMPS, for straight pipes, 3in. to 48in. dia.; Two Pumps for special pipes, 3in. to 42in.; and One Pump for straight and specials, 3in. to 6in., with Overhead Traveller; Set of BERRY'S PUMPS driven by 20 H.P. Shunt-wound Motor, with COMPRESSOR driven by 20 H.P. Shunt-wound Motor; Ten Motor-driven CUTTING-OFF MACHINES, for pipes 3in. to 42in. dia.; Six Motor-driven LOAM MILLS and connections suitably housed, and Motor-driven Mortar Mill; DIPPING PLANT, with Motor-driven Cranes, for 9ft. pipes up to 16in. dia.; DIPPING PLANT and Motor Crane for 12ft. pipes from 3in. to 48in. dia., with delivery gantries to Loading Wharves.

THE ENGINEERING EQUIPMENT

consists of THREE FITTING SHOPS, WITH TWO 3-MOTOR 10-TON OVERHEAD TRAVELLING CRANES; the ranges of Line Shafting driven by 150 H.P. Positive Scavenger Gas Engine and connections from Mond Gas Plant, and the full equipment of massively constructed Lathes, Planing, Slotting, Shaping, Drilling, and Boring Machines; SMITHS' SHOPS, with Two Pilkington Steam Hammers, 3 and 5 cwt.; C.I. Hearths, with Motor-driven Keith-Blackman Fan; a 12-ton Goliath Crane, with compound-wound single 20 H.P. Motor, working between Foundries and Fitting Shops; PATTERN SHOP, with motor-driven Lathes, &c.; SAND MIXING SHED and Motors therein; the various Brick and Wood-built STORES and Fitments therein; SAW MILL, with Saw Bench to take 4ft. 3in. dia. saw, and 26 B.H.P. Shunt-wound Motor drive.

LARGE BRIDGE BUILDING YARD,

with 150 H.P. Positive Scavenger Gas Engine; Two Goliath Travelling Cranes to lift 12 tons, mounted on rails, with 20 H.P. Compound-wound Single Motors; a 12-ton Scotch Derrick Crane, with 27 H.P. Series-wound Single Motor; Two Foundry Delivery Jib Cranes, with 10 H.P. and 3 H.P. Series-wound Motors.

THE POWER AND LIGHTING PLANT,

CONSISTING OF TWO 10-TON MOND GAS PRODUCERS EQUAL TO 2000 H.P.

and Feed Gantry, with 40 H.P. Vertical Engine; Two Cameron Pumps, 11in. by 7in. by 10in.; a Thwaites No. 3 Blower, Two Superheaters, Air Heating and Gas Cooling Towers, Washer with Dashers, Gas Holder of 2000 cubic feet capacity, Gas Washing and Momentum Fan, Two Settling Tanks and Two C.I. Sawdust Scrubbers and all connections to Two 250 H.P. Positive Scavenger Gas Engines, by the Premier Gas Engine Co., coupled direct to Two 150 K.W. Dynamos, with Switchboard, housed in massively constructed Power-house, with a Tangye's Hand Overhead Travelling Crane, with 8-ton Brake Crab and set Weston's Geared Differential Blocks, tested to 13 tons; the Distributing Mains supplying current to the Cranes, Pumps, and Motors about the Works, with 8½ Miles Aerial and Vulcanised Cable to Lighting and Power Points, carried on 12,468ft. run of Poles in 11 tons C.I. Pipe Sockets, with all Fittings and Lamps. AN AUXILIARY LIGHTING AND POWER PLANT, separately housed, consisting of Two 40 H.P. Engines and Two 24 K.W. Dynamos, and all connections, with interchange Switch to the Main Power-house.

A CAREFULLY ESTIMATED DEPOSIT OF

ABOUT 500,000 TONS OF FURNACE SLAG,

with Motor-driven Cracker Plant on permanent way siding, with Tramways and Loading Stallages. This Slag is at present being hand worked, and consists of a large percentage of Cold Blast Slag.

113 ACRES OF FREEHOLD IRONSTONE MINES AT ADDERBURY,

near BANBURY, OXON, which comprises a Very Desirable

AGRICULTURAL HOLDING KNOWN AS "ST. MARY'S,"

consisting of RICH and WELL-WATERED PASTURE and Sound ARABLE LAND, in the occupation of Mr. John Bennett on a yearly Old Michaelmas tenancy at a rental of £224, and

64 ACRES OF UNGOTTEN LEASEHOLD IRONSTONE MINES

ADJOINING THE FREEHOLD, and connected with the G.W. Rly. at Adderbury Station by permanent Sidings, and a system of 24in. gauge Tramways to the various faces of work, in all about 150 tons of Rails and Chairs, Hauling Engine and Gear, and Fixed Weighbridge.

The purchaser will be required to take, at a Valuation to be made in the usual way, the Quarry and other Loose Tools, 61 Wood Side-tip Wagons, and Sundries at Adderbury; and One Peckett and Three Hunslet Tank Locos., 3ft. 8in. gauge; 80 new specification 10-ton Railway Trucks, all recently overhauled; 20 Horses, with 15 Carts and Tackle; the varied and carefully assorted equipment of Boxes, Axlets, Rings, &c.; Loose Plant, Tools, &c., other than those enumerated in the Schedule of Fixed Plant; the unconsumed Stock of Pipes and Stores; a Sentinel 5-ton rubber-tyred Tipping Steam Wagon; a Mann's Patent 3-ton Steam Wagon; Laboratory and Office Furniture and Effects; Electrical and Furnace Sundries; about 15,000 Tons of Adderbury fire (7000 tons of which is stacked with 700 tons slack and ready to fire); about 900 Tons Flue Cinder, the whole of which lie on and about the Woodside Works, a schedule of which is in preparation and which will be ready prior to the Sale.

Plans of the Woodside and Adderbury Properties, with Condensed Schedules of the Erections and Fixed Plant which is included in the Sale of the Concern, and Conditions of Sale appertaining to the same, are being prepared, and may be had on application to Messrs. BEALE and CO., Solicitors, 12, Newhall-street, Birmingham (Tel., Central 3505); or to the 5722 J

AUCTIONEER, 2, PRIORY STREET, DUDLEY (Tel. 2288).

SITUATIONS OPEN (continued)

ENGINEER, with Extensive Knowledge of Power Station Accessories, particularly Water Coolers, Air Filters and Ventilating Plant, REQUIRED by South of England Firm, as Assistant to Manager. Must have large experience in selling, estimating, correspondence, and be capable of Taking Complete Charge. Applications, with fullest curriculum vitæ, stating salary required.—Address, 5751, The Engineer Office. 5751 A

ELECTRICAL and MECHANICAL ENGINEER, not over 30, must be straight and keen, to assist old and well-connected consulting firm in Birmingham. State education, practical experience and initial salary.—Address, P9099, The Engineer Office. P9099 A

GENERAL MANAGER REQUIRED for a Large Structural and Gas Engineering Works in the Midlands (Birmingham district), employing about 700 hands. Applicants must have had a thorough theoretical and practical engineering training in the Design and Construction of Gasholders, Purifiers, Gas Plant and Structural Steelwork; must be fully qualified to work out calculations of stresses and strains, and to take general administrative management.—Apply by letter (which will be treated confidentially), stating age, experience and salary expected, to Z. H. H., care of Deacon's, 7, Leadenhall-street, London. 5761 A

INSPECTOR, to Take Charge of the Final Inspection in a factory making a highly specialised product in sheet metal. Successful applicant must have mechanical ability and have had experience as an inspector heretofore. State age, expected wages and a full and detailed account of past experience.—Address, 5753, The Engineer Office. 5753 A

SITUATIONS OPEN (continued)

INDIA.—ENGINEER.—SALESMAN WANTED for an English Firm in Bombay; must have thorough knowledge of Steam Power Plant and Mill Gearing. General Technical Knowledge and Drawing-office Experience essential. Single man, under 30, preferred. Permanent post with good prospects for the right man. Salary according to qualification.—Address, stating briefly training and experience, 5731, The Engineer Office. 5731 A

PRACTICAL ENGINEER WANTED for Punjab. Required at once for Operation and Supervision of Natural Gas and Oil Engines and Pumps in an Oilfield. Previous experience of Running Gas and Oil Engines essential; must be capable of Operating such Engines of various types. Age 22/26, unmarried. First agreement, three years. Salary:—
1st year, Rupees 300/- per month.
2nd year, Rupees 350/- ,,
3rd year, Rupees 400/- ,,
Plus Rupees 120/- month field allowance. The Company also contributes one month's salary per annum to provident fund. Passage paid.—Write, with full particulars and copies of testimonials, to Z.Z.527, care of Deacons', Leadenhall-street, London, E.C. 3. 5762 A

RATE FIXER REQUIRED (London District). Must have good recent experience in Laying-out Operations and Fixing Prices for Manufacture of Motor Parts in large modern factory.—Address, with full particulars and copies of testimonials, 5752, The Engineer Office. 5752 A

REPRESENTATIVE REQUIRED, London Area. Essentials:—Good practical experience Mechanical Engineering Power Plant, sound connections and undoubted selling ability. Remuneration commission basis with small minimum guarantee.—Address, 5734, The Engineer Office. 5734 A

SITUATIONS OPEN (continued)

WANTED, First-class DRAUGHTSMAN for the North of England, with experience in the Design of Machinery for Stone Crushing, Screening and Cement-making and the Lay-out of Complete Plants.—Address, 5726, The Engineer Office, stating details of experience, age and salary expected. 5726 A

WANTED, JUNIOR DRAUGHTSMAN, Used to Designing Heating Installations.—Apply, THE BRIGHTSIDE FOUNDRY and ENGINEERING CO. Ltd., 29, St. Mary-street, Cardiff, stating age, experience and salary required. 5737 A

CHIEF DRAUGHTSMAN for Aircraft Work. State age, experience, and salary required.—Address, 5616, The Engineer Office. 5616 A

CHIEF DRAUGHTSMAN WANTED by Lancashire Engineering Firm manufacturing Heavy Machinery and Furnaces; must be experienced organiser and have good technical qualifications; commencing salary £400 per annum.—Address, with fullest data, P9104, The Engineer Office. P9104 A

CONSTRUCTIONAL DRAUGHTSMAN REQUIRED for the East, with sound knowledge of Steelwork Design and with experience in Building Work, Concrete and Earth Work. Three years' agreement. Salary £[illegible] annum upwards. Free passage out and home, and free furnished quarters (but not messing). Age 22-28, single.—Write, with full particulars, to Box O., c.o. the Regent Advertising Service, Ltd., 4, London Wall-buildings, London, E.C. 2. 5766 A

DRAUGHTSMAN (LEADING) REQUIRED by Midland Firm of Structural Engineers. Experienced in Bridge and Structural Steelwork and competent to deal with jobs of magnitude.—Address, 5727, The Engineer Office. 5727 A

DRAUGHTSMAN REQUIRED for Work in London, with large firm of Mechanical Engineers; must be thoroughly experienced in Belt Conveyor Work handling all materials.—Address, stating age, experience and salary required, 5760, The Engineer Office. 5760 A

DRAUGHTSMAN REQUIRED for Large Engineering Works; knowledge of Refrigerating Machinery essential; state age, experience and salary.—Address, 5709, The Engineer Office. 5709 A

DRAUGHTSMEN REQUIRED TEMPORARILY for Structural and General Railway Work.—Address, stating age, full particulars of experience and salary required, 5774, The Engineer Office. 5774 A

DRAUGHTSMAN REQD., with Exp. Oil Refinery Designs and Creation. Read. for East. Aged 27/32, single pref. £460/700 p.a.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 5747 A

EXPERIENCED DRAUGHTSMAN REQUIRED. Aircraft experience essential. State age, salary required and qualifications.—Apply, Box 656, T. G. BROWNE'S, Advertising Offices, 163, Queen Victoria-street, E.C. 4. 5612 A

WOODWORKERS and ERECTORS for Aircraft Works, S.W. Coast. Good opportunities for competent men.—Address, 5617, The Engineer Office. 5617 A

SITUATIONS WANTED

A LIVE FOUNDRYMAN, with Unique Experience in all classes of non-ferrous metals, intimate knowledge of mixtures, casting, and conversant with latest methods for commercial production, including moulding machines. Highest references. Disengaged.—Address, P9094, The Engineer Office. P9094 B

CHARTERED CIVIL ENGINEER (35). University graduate, B.Sc. (Engineering), A.M.I.C.E., &c., with many years first-class experience in design, construction and management of ferro-concrete contracts for varied kinds of work, accustomed to control of D.O., and other subordinate staff, DESIRES CHANGE in similar class of work, either home or abroad.—Address, P9093, The Engineer Office. P9093 B

DIESEL ENGINEER (30), Well Educated, 1st Class B.O.T. Steam and Diesel Certificate, Ex.-Lieut. R.N.R., free July, experience supervising upkeep and repair of steam and Diesel machinery, turbines, water-tube and other boilers, workshop practice, &c., SEEKS POSITION of responsibility.—Address, P9087, The Engineer Office. P9087 B

ENGINEER (30), Shops, Marine, D.O. Experience, steam pumps, evaporators, elec. lighting installation, maintenance, B.O.T. Certificate, smart appearance, hard worker, excellent refs., DESIRES POST.—Address, P9090, The Engineer Office. P9090 B

ENGINEER (33), Shop, D.O., Estimating, Buying and managerial exp. with general engineers, DESIRES APPOINTMENT, home or abroad.—Address, P9088, The Engineer Office. P9088 B

ENGINEER (32), A.M.I. Mech. E., SEEKS POSITION, home or abroad; general mech. and commercial exp.; 8 years buyer London office export merchants.—Address, P9109, The Engineer Office. P9109 B

ENGINEER and DRAUGHTSMAN (32) REQUIRES a responsible POSITION. Good worker and organiser, considerable ability and experience. Willing to make a small investment if required.—Address, P9089, The Engineer Office. P9089 B

ENGINEER, Mechanical and Electrical, 16 Years as engineer and works manager, DESIRES SIMILAR POST. Accustomed to all classes of machinery and establishment lay-out and upkeep; charge of large steam and gas power plants, electric, hydraulic and pneumatic installations.—Address, P9107, The Engineer Office. P9107 B

ENGINEER SEEKS POSITION of Permanent character in good firm of consulting marine engineers. Holds B. of T. chief engineer's certificate; has had experience in Diesel work, supervision of repairs to machinery, boilers and ships, and from October, 1919, to June, 1923, has represented a firm of consulting marine engineers on the Continent. Willing to invest capital.—Address, P9052, The Engineer Office. P9052 B

MAN, Fully Competent in Smelting and Refining of all aluminium residues, capable of taking complete charge of foundry and casting shop, SEEKS POSITION ABROAD.—Address, P9108, The Engineer Office. P9108 B

MARINE ENGINEER (33), 1st Class B.O.T. Certificate, 8 years' experience as manager, ship repairing works, also consulting work, SEEKS POSITION with good firm marine consulting engineers or management ship repairing works, at home or abroad. Wide experience all classes ship repairs, supervision of building of new vessels, surveys, reports, and expert knowledge prices.—Address, P9096, The Engineer Office. P9096 B

MECH. ENGINEER (36), 1st Class B.O.T., Lately returned from the East, SEEKS POSITION at home or abroad. Experience: erection and maintenance of large textile mills, workshop and foundry management, including launch, cargo boat and jetty repairs.—Address, P9100, The Engineer Office. P9100 B

METALLURGICAL ENGINEER, with 15 Years' experience blast-furnaces, open hearths, and rolling mills, SEEKS EMPLOYMENT in England or abroad. Speaks French, Russian. Best references.—Address, 5694, The Engineer Office. 5694 B

TANK EXPERT WISHES to REPRESENT Good FIRM, also gas and coke oven plant, constructional and general work, N. of E.—Address, P9106, The Engineer Office. P9106 B

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Waterloo Bridge.

WITH great suddenness it was decided last Saturday to close Waterloo Bridge to all traffic after midnight on Sunday. The sagging of the defective arch had become very pronounced, but up to quite a late hour it was officially held that there was no danger of collapse. Indeed only a week ago it was anticipated that it would be practicable to keep the bridge open for the next nine months or so until the temporary structure to be erected on the down-stream side, by Sir William Arrol and Co., Limited, was completed. Even yet, it is authoritatively stated, the sinking of the foundations, although serious, need not cause alarm. The closing of the bridge to public traffic is in fact likely to be temporary only. The step has been taken, it is announced, simply as a precaution and as a means of facilitating the repair work which has been in progress for some time past. It is possible that the bridge, after the temporary repairs have been finished, will be re-opened in a few weeks' time. Meanwhile the traffic which formerly traversed it has been diverted to Westminster and Blackfriars Bridges. The extra burden thus thrown upon the Westminster structure is in itself a cause for some anxiety, for it has been carrying in the ordinary way more than its proper weight of traffic for a number of years, and some doubts have been expressed on its safety.

The Berengaria's Gyroscopic Equipment.

WE are informed that on the Cunard liner Berengaria, the latest type of Sperry compass has now been installed. The new equipment consists of a master compass situated in the wheel-house and five repeater compasses—four on the navigating bridge and one in the wireless room for use in conjunction with a Marconi direction finder. A thirty-day automatic course recorder is also fitted on the bridge. In addition, the equipment includes a Sperry gyro-pilot or "automatic helmsman," whereby a given course once set is preserved without the steersman's interference. The Berengaria is not the first, but she is certainly the largest, British vessel to be equipped with means for automatic steering. The first British vessel to be so equipped was the Cunarder Laconia, which in December last year returned from New York with the device in action. In the arrangement of the details there is no direct connection between the automatic helmsman and the wireless direction finding equipment—that is to say, the vessel is not automatically steered by the directional signals—but such a development is not outside the bounds of development in the near future.

The Helicopter Competition.

WHEN the conditions of the British helicopter competition for prizes totalling £50,000 were announced by the Air Ministry in May of last year, we expressed the opinion that they were hopelessly ambitious, and nothing in the way of progress of which we have heard since has led us in the least to alter that view. The entries for the competition closed at the end of last month, and although no official announcement has been made on the subject, it is stated that about 15 have been received. These machines have from now onwards to April 30th next year in which to complete the prescribed tests. We await the results with interest, but with no hope that the conditions will be fulfilled. In France M. Oemichen, an inventor who has for long given attention to and experimented with this class of machine, has just created a record by flying in a closed circuit of a little more than a kilometre in length. The flight lasted 7 min. 40 sec., and the height attained was in general about 3ft., with 10ft. as the maximum. The Air Ministry conditions call for a speed of at least 60 miles an hour, or about ten times the speed reached by M. Oemichen, and require the machine to be capable of ascending to 2000ft. vertically, of hovering at that height for half an hour, and of flying thereat over a closed circuit of 20 miles or more. Comparing these figures with those realised by the French experimenter, we can only repeat that in our view the British competition is not meant to be taken very seriously.

Mine Haulage Ropes

THE inquiry by the Chief Inspector of Mines, Sir Thomas Mottram, into the disaster at the Nunnery Colliery, Sheffield, on December 3rd, was concluded last week. It will be recalled that as a result of the breaking of a haulage rope a "paddy" train ran away on an incline, seven men being killed and many injured. It was strongly urged during the inquiry that mine owners should be compelled to test haulage ropes themselves, and not be permitted to rely on the tests carried out by the makers of the ropes. An important technical point was also revealed. Professor Hay, of Sheffield University, following an examination of the rope that broke, expressed the opinion that eight out of the forty-two wires in the rope were broken before the accident occurred, but that as the fractured wires were in the interior, there would have been no external sign of weakness. The question thus presents itself to us whether a wire rope fails under tension by a preliminary fracturing of the internal wires, followed almost at once or later by the fracture of the outer wires. Recent investigations conducted by Professor Haigh at the Royal Naval College, Greenwich, point strongly towards the belief that fracture in a solid specimen of metal begins in the core of the metal and spreads outwards, incidentally changing its nature as the periphery is approached. The fracture appears to follow this procedure, whether the specimen is under steady, repeated or alternating stress. Doubtlessly the mechanism of failure of a wire rope is very much more complex than that of a solid specimen, but it is possible that it exhibits the same phenomenon of fracture initially in the interior as Professor Haigh has detected in solid specimens.

Wireless Direction Finding.

IN the House of Commons Mr. Wedgwood Benn recently asked the President of the Board of Trade whether he was in a position to supply information as to the existing direction-finding facilities for ships approaching the coasts of the British Isles, and what new wireless direction-finding stations were contemplated and might be expected to be constructed in the near future. Commenting on the official charge of 5s. which is made for each message sent to a ship, indicating her bearing from a wireless direction-finding station, Mr. Benn said that stations in Canada, the United States, France, and elsewhere supplied this information to ships of all nationalities entirely free of charge, and he hoped that the authorities would consider the desirability of abolishing the charge made by the wireless stations in this country. Replying, Mr. Alexander said that at present there were direction-finding stations at Berwick, Flamborough, and at the Lizard, and new stations were contemplated in South Wales and at Niton, in the Isle of Wight. He was aware that in certain countries no charge was made for giving ships bearings, but in view of the cost of the service in this country he did not consider that the whole of the expense should be borne by the Exchequer.

The Wireless Beam.

IN a lecture on "Wireless Navigation of Ships and Aircraft," recently delivered at the Royal Society of Arts, Dr. Robinson referred to the wireless beam system of direction finding developed by Marconi and Franklin. He stated that this method had obvious advantages over other systems. There is no doubt that eventually it will be widely used. Its principal advantage is, as Dr. Robinson explained, that all the technical work is concentrated at one spot and the observations of bearings can be left to unskilled people. A special short wave receiver must, of course, be provided on the ship, but this is not by any means a serious disadvantage. The revolving beam transmitter which has been erected on Inchkeith in the Firth of Forth has given very satisfactory results, and although its range is not very great, it has served to demonstrate the value of directional wireless in connection with navigation.

A New Boat Lowering Gear.

AN interesting feature of the trials of the Tairea, a twin-screw passenger steamer recently completed by Barclay, Curle and Co., Limited, for the British India Steam Navigation Company, Limited, was a demonstration of the Maclachlan boat-lowering apparatus with which the vessel is fitted. The Tairea is the first ship to be provided with this new gear, which, we may recall, was referred to by Sir Westcott Abell in the Thomas Hawksley lecture given by him in November last before the Institution of Mechanical Engineers. The main feature of this apparatus is the use which is made of the force of gravity in lowering the boats right from the stowed position into the water, permitting the operation to be carried out by one man alone. With the Maclachlan gear the officers in charge of the boats are no longer dependent on the assistance of the ship's crews when boats are required to be launched in an emergency. During the tests carried out on the Tairea it was shown that the time occupied from the releasing of the boat grips until the boat reached the water through a vertical distance of 40ft. was between 20 and 28 seconds, all operations being performed by one officer. The boat falls, which are of single wire rope, are conveniently stowed on a small hand winch, while the boat davits are mounted on rollers which move over parallel tracks laid at right angles to the ship's side and carried down it to the embarkation deck forming the ship's side deck supports. The tracks extending inboard on the boat deck have a downward slope from the inside outwards of 30 deg. to 35 deg. When launching, the davits and the boat move under their own weight until the davits reach the stoppers, and the boat continues its drop till the water is reached. Nested boats are handled equally well, and the system permits of more economical use being made of the boat deck. The chief claims made for the Maclachlan boat gear are its simplicity, the fact that it will operate with the greatest list, and the further fact that the launches are made quickly and by one man only. The gear, which is supplied by the Maclachlan Boat Davit Company, of 247, West George-street, Glasgow, will, we understand, be fitted on nearly all the new liners under construction.

The British Industries Fair.

THE Birmingham section of the British Industries Fair was opened to the public at Castle Bromwich on Monday, and will remain open until the 23rd. It is noticeable, in going round the exhibition, that the concurrent show at Wembley has had a considerable effect on the number of exhibitors at Birmingham. The space occupied by the stands is not quite so great as at past Fairs, and the proportion of engineering exhibits is naturally less. The Fair is, in fact, composed principally of that class of hardware for which the Birmingham district is noted. Many of the engineering firms which have been in the habit of exhibiting at the show have sent their stands to Wembley this year, while others who are represented at Birmingham have similar stands at the British Empire Exhibition.

A Tug's Adventurous Atlantic Voyage.

ON his arrival at Liverpool on Monday morning last Captain J. C. Leslie, of Glasgow, gave an interesting account of an Atlantic voyage he made together with a crew of twelve men on the tug Salvage Prince, a craft of about 60 tons burthen. It is believed that this tug is the smallest vessel which has crossed the Atlantic under its own power, and the crossing was, moreover, made during a spell of very rough weather. The Salvage Prince was built by Cochrane and Sons, of Selby, on the Humber, and was safely delivered to its owner, Captain Pyke, of Kingston, Ontario, who received her at Montreal on May 1st. The trip, which was begun on April 11th, lasted exactly twenty days, and during this time 100 tons of coal were burned. In order to save time the northern route by the North of Scotland, the Pentland Firth, and then right across to Cape Race was chosen, instead of the southern route *viâ* the Azores and Bermuda, which is usually chosen by small craft. Very heavy swells were encountered and the decks were under water most of the time, but the hazardous journey was accomplished without any serious accident. Another tug which has recently set out on a very long maiden voyage is the Neptuno, which was built and engined by John I. Thornycroft and Co., Limited, at Woolston, Southampton, for the Sao Jeronymo Coal and Mining Company, of Rio Grande do Sul. This small vessel, which started for Rio on the 9th inst., is 85ft. long with a breadth of 20ft. and a depth of 10ft. 3in., with a designed speed of 10 knots. She is a single-screw tug with inverted surface condensing engines and coal-fired boiler. The vessel has been specially designed for use in tropical climates. On her trials a speed of 10.27 knots was attained.

The Unsinkable Ship.

IN welcoming the delegates attending the International Shipping Conference in London on Tuesday, Sir Alan Anderson, president of the Chamber of Shipping of the United Kingdom, referred to the problems with which the Conference was faced. These problems, he submitted, including, as they did, questions relating to subdivision, load line, deck cargoes, boats and wireless equipment, could all be grouped under the one heading of "Safety of Life at Sea." In his opinion, the unsinkable ship was a myth, and a dangerous myth if it induced false confidence. A modern ship properly handled would not sink unless she collided with another ship, a rock or an iceberg. In such a circumstance it might well sink in spite of all bulkhead, load line and deck cargo regulations, and the lives of all aboard would be in peril in spite of life belts, rafts and boats. The one absolute safeguard at sea was a vigilant master, but bulkheads and other precautionary measures might mitigate disaster, and they were more likely to prove useful if the regulations which governed them were wisely framed. Sir Alan said that it was evident that the shipowners of all nations thought that the existing rules were less efficient and more burdensome than they might be. He was pleased to say that the reports of all the Committees dealing with the various subjects engaging the attention of the Conference were, with one exception, unanimous. An account of the Conference proceedings appears elsewhere in the present issue.

Engineering Trade Conference.

ON Wednesday a conference of unusual interest was opened in London between the Engineering and Allied Employers' National Federation and the representatives of fifty-one trade unions concerned in the engineering industry. The Conference was convened by the Employers' Federation in order that the present unsettled conditions of the industry and the steps necessary to attain stability and satisfactory conditions of employment might be frankly discussed with the workpeople. After statements had been made by Sir Allan Smith and Mr. J. T. Brownlie, the conference was adjourned until Thursday next.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. IV.*

LOCOMOTIVE DEVELOPMENT.

By J. H. BRITTAIN, M.I. Mech. E.

IN the Palace of Engineering at the British Empire Exhibition are exhibited one of the latest London and North-Eastern Railway (Great Northern) three-cylinder locomotives, "The Flying Scotsman," and the Great Western four-cylinder locomotive, "Caerphilly Castle." Granted that these majestic machines will command the interest of the casual visitor, opportunity is taken here of comparing some of their characteristics, so far as the available "external data" will allow, and of contrasting them with Sir Vincent Raven's three-cylinder Pacific, which, however, is not shown at Wembley. All three engines are illustrated herewith, and a two-page drawing of the Great Western engine appears as a Supplement to to-day's issue, with cross sections, &c., on page 529. The North-Eastern and the Great Northern locomotives are three-cylinder engines with similar diameter of driving wheels and length of stroke, but the boiler pressure for the N.E. engine is 200 lb. per square inch with cylinders 19in. diameter, and for the G.N. engine 180 lb. per square inch with cylinders 20in. diameter. The Great Western is a four-cylinder engine, with 16in. diameter cylinders, 225 lb. per square inch boiler pressure and 6ft. 8½in. driving wheels; the length of stroke being 26in., as on the N.E. and G.N. engines.

A point of contrast is that whilst the boiler barrels of the Great Northern and Great Western engines open out at the back ring, the North-Eastern boiler follows the parallel form. In the fire-boxes, the G.W. retains the "Belpaire" type, while the N.E. and G.N. adopt the round top type, rendered necessary by the height of the boiler from rail level and by consideration of the space available for the cab front windows.

All the cylinders of the N.E. engine drive the leading coupled wheels; those of the G.N. drive the middle coupled wheels. The inside cylinders of the G.W. engine drive the leading coupled wheels and the outside cylinders drive the middle coupled wheels. This divided drive reduces crank axle stresses. The inside cylinders of the G.W. are placed almost centrally over the bogie front axle, and the outside cylinders similarly over the bogie hind axle; weight is thus equally distributed, and a suitable length of connecting-rod provided for. The bogie trailing wheels are in the same position relative to the leading coupled wheels in the G.N. and G.W. engines, and are of the same diameter whereas the G.W. bogie has a 9in. longer wheel base, necessitated by considerations of cylinder arrangement and weight; it is also fitted with a brake. The bogie of the N.E. engine is, owing to the first axle drive, placed well forward to permit the length of connecting-rod necessitated by the cylinder arrangement. The tender of the G.N. engine is the only one mounted on four wheels; it will be noted, however, that its coal and water capacity is considerably higher than that of either the N.E. or G.W. tenders.

In passing, it will be apparent that the N.E. and G.N. engines having the same wheel disposition, both using a one-axle drive, but off different axles, an excellent opportunity is presented to compare the amount of transverse vibration and rolling or swaying of a first axle drive with a short couple and a second axle drive with a long couple.

TABLE I.—*Weights per Foot Run of Wheel Base.*

	Bogie. Weight / Wheel base.	Coupled wheels. Weight / Wheel base.	Engine. Weight / Wheel base.	Tender. Weight / Wheel base.	Engine and tender. Weight / Wheel base.
	Tons.	Tons.	Tons.	Tons.	Tons.
North-Eastern	2.923	4.00	2.609	3.639	2.308
Great Northern	2.728	4.13	2.586	3.518	2.443
Great Western	3.000	3.98	2.930	3.333	2.198

Weight Percentages.

	Of engine weight on leading bogie.	Of engine weight on trailing truck.	Of engine weight used for adhesion.	Of engine weight to total weight of engine and tender.
	Per cent.	Per cent.	Per cent.	Per cent.
North-Eastern	19.58	18.55	61.85	67.78
Great Northern	18.44	16.65	64.89	62.15
Great Western	26.29	—	73.70	66.62

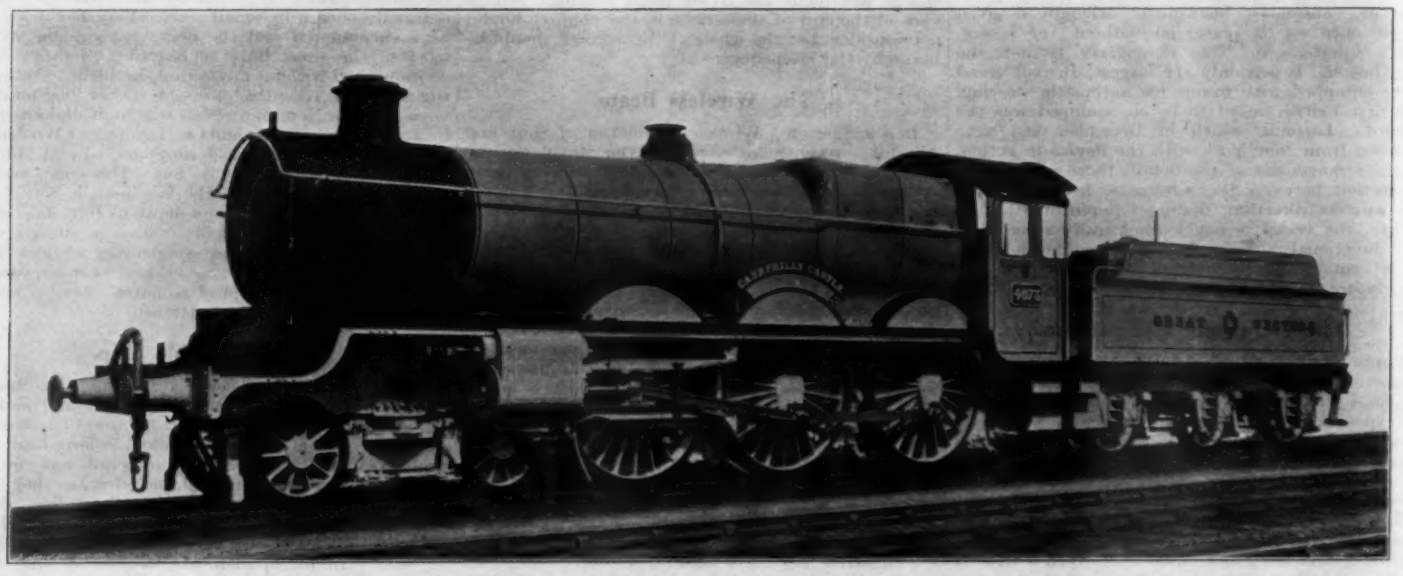


FIG. 81—GREAT WESTERN—FOUR-CYLINDER SIX-COUPLED LOCOMOTIVE "CAERPHILLY CASTLE."

In the accompanying tables due consideration must be given to the comparative weights of the locomotives. For engine weight only, the G.W. is 82.31 per cent. of the N.E. and 86.37 per cent. of the G.N.; and the G.N. is 95.30 per cent. of the N.E. For engine and tender weights, the G.W.

WEIGHTS.

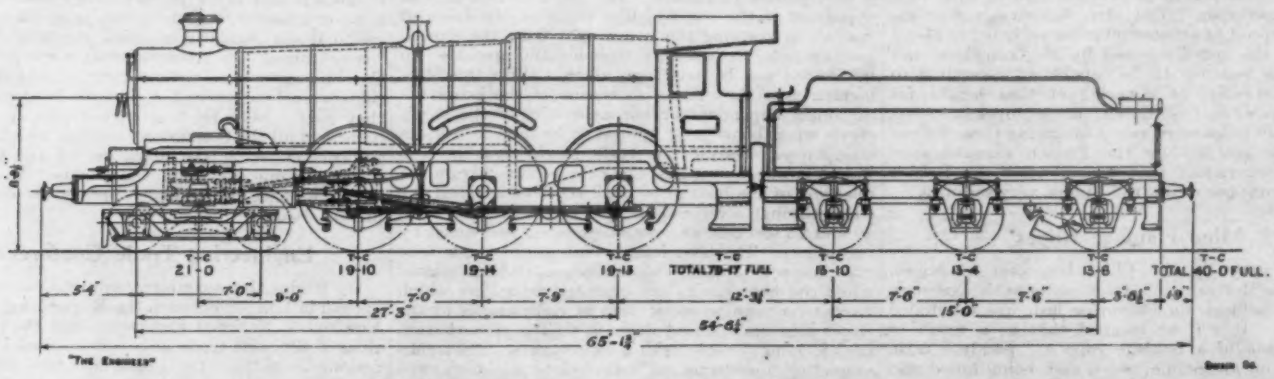
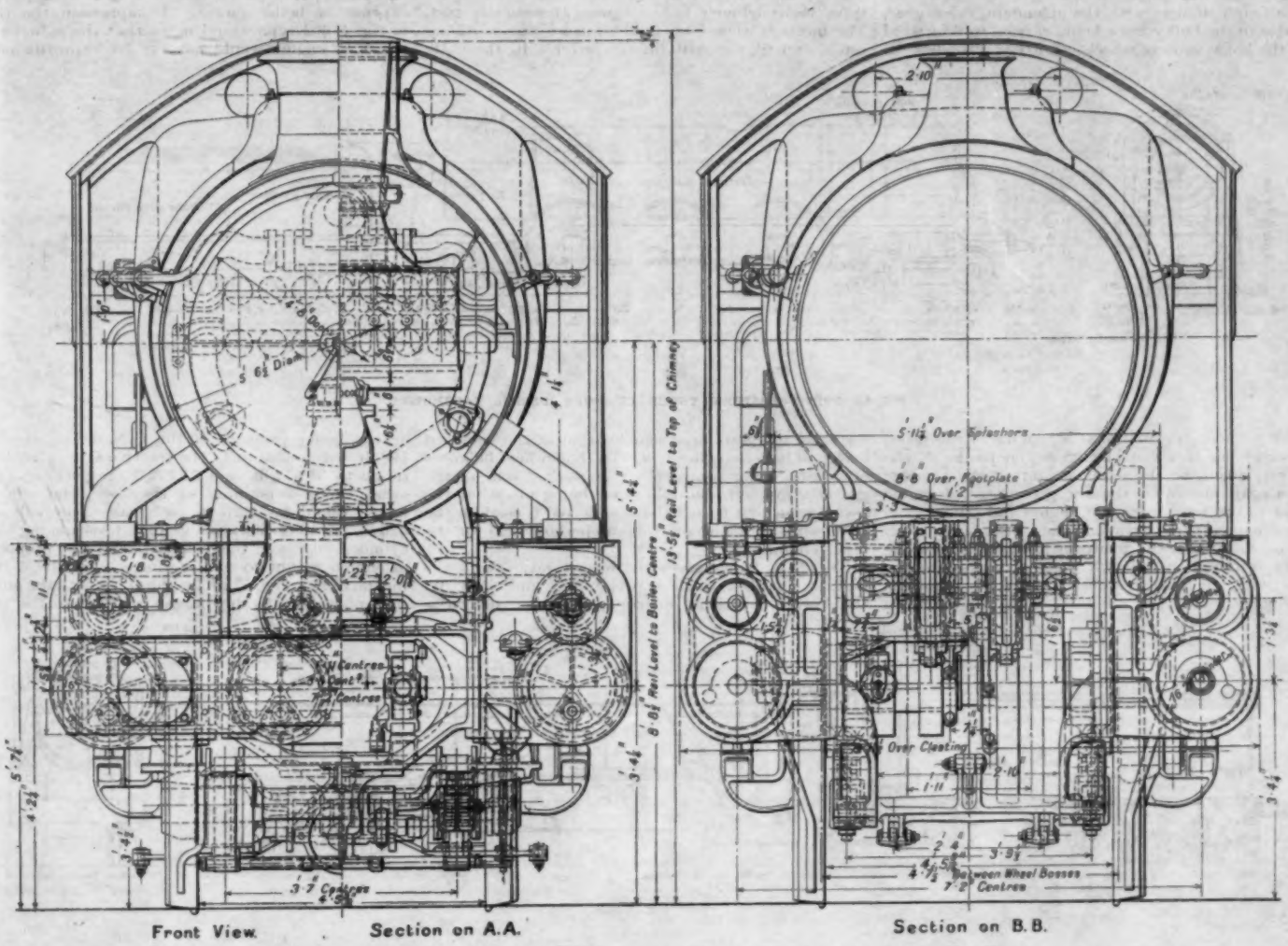


FIG. 82—WEIGHT DIAGRAM OF THE "CAERPHILLY CASTLE."

* No. III. appeared May 9th.

GREAT WESTERN—FOUR-CYLINDER LOCOMOTIVE "CAERPHILLY CASTLE."



is 83.75 per cent. of the N.E. and 80.57 per cent. of the G.N.; and the G.N. is 96.20 per cent. of the N.E.

Table I. gives the weight per foot run of wheel base and the distribution of weight in percentages. It will be seen that the G.W. engine is heavily loaded at the leading bogie, not only owing to the disposition of the four cylinders with the attendant valve gear, but also to the boiler front being carried well forward over the bogie trailing wheels, and that although the weight per foot run of the G.N. engine is the least, its weight per foot run of engine and tender is the greatest, owing to the great weight of the tender; this is again shown by the low percentage of engine weight to the total weight of engine and tender.

The comparison between the N.E. and G.N. engines, shows that the greater percentage of adhesive weight is found in the G.N. engine, whilst for the bogie and truck percentages the N.E. engine is the higher. The N.E. engine, with its extended boiler barrel and frames, &c., to accommodate the arrangement of its first axle drive, produces a weight of 39 cwt. above that on the G.N. bogie, which it will be noted, is well tucked under the leading coupled wheels. Again, at the hind end, the N.E. engine, with its truck wheels 18in. closer to the trailing coupled wheels than those of the G.N. engine, and the consequent longer overhang of the fire-box with the frames extended to give crew accommodation, produces a weight 52 cwt. above that on the G.N. truck. Weight consideration on trailing trucks of engines of this type must ever be an important matter of design, owing to their riding and tire wear.

It is interesting to note that while the N.E. engine is the heaviest, its percentage of engine weight to total weight of engine and tender is the highest, indicating a moderately weighted tender, whereas the G.N. is the lowest, showing, as previously stated, a heavily weighted tender. In this connection, there is a great difference in the coal and water capacities of the tenders under notice, but no doubt they are in accordance with the requirements of service conditions.

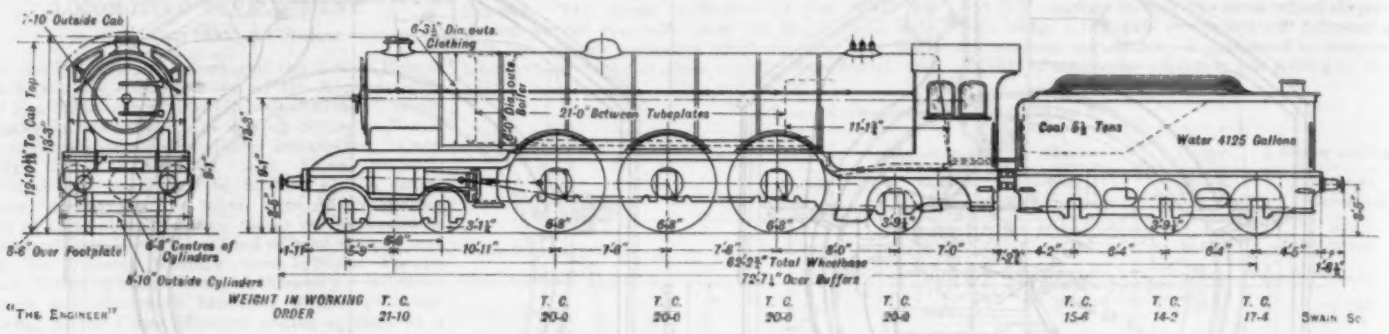


FIG. 83—NORTH-EASTERN—THREE-CYLINDER PACIFIC LOCOMOTIVE.

Boilers.

Table II. shows the heating surfaces of the respective engines, with their ratios.

The N.E. boiler is the longest and the greatest in diameter, but carries the least number of tubes. The G.W. boiler is the smallest in size and carries the greatest number of tubes; practically 50 per cent. more than the N.E. boiler.

With the N.E. and G.N. fire-boxes of larger dimensions, it will be apparent that they will show a higher volume-to-surface ratio than that of the G.W., although the latter shows the greater fire-box heating surface-to-grate ratio; not always a reliable figure for the measure of combustion efficiency, so far as bituminous coal is concerned. A striking feature of the G.N. and G.W. boilers, the former set for 180 lb. and the latter for 225 lb. working pressure, is the fact that the G.N. carries exactly twice the amount of superheater surface that the G.W. engine does. It is remarkable how the amount of superheater surface varies in its ratio to the boiler heating surface, not only in the particular instance under notice, but in a general survey of instances which have come under the writer's observation.

One aspect of these latest British locomotives which will provide food for digestion is that very controversial point, whether the grate area is of major or minor importance in locomotive design. In the N.E. and G.N. cases particularly, the grate area shows a great increase over that of previous engines; in the 4–6–0 type, three-cylinder N.E. (Class S 3), it was 27 square feet; and in the 2–8–0 type, three-cylinder G.N., it was 27.5 square feet. The increase, therefore, in the former case is 52 per cent., and 61 per cent. in the latter. In the G.W. instance, the grate area remains that of the standard design of boiler and fire-box. The boiler heat balances offer interesting comparisons, if worked out on the gas flow method, due allowance being made for the assumption that best Welsh steam coal is used for the G.W. and Yorkshire or Northumberland coal for the other engines.

The N.E. boiler gives the lowest ratios with the highest superheat surface percentage, and the G.W. the lowest superheat surface percentage, its ratios otherwise agreeing very well with those of the G.N. boiler. Parenthetically, the superheat surface is given in the lower divisions of the table, per ton of adhesive weight and of engine weight in each case. The figures given are capable of being much further developed on the weight for weight basis, but for present purposes they will suffice to indicate the measure of variations generally between the two types of engines, so far as their boiler ratios and engine weights are concerned. It will be evident that the respective boiler efficiencies and evaporative capacities will vary considerably, but it is not within the scope of this article to go into this interesting aspect of the question.

Table III. shows the tractive force and ratios, and the tractive force per pound of mean effective pressure.

The adhesion in Column 2 shows a variation between 497 lb. per ton in the G.N. and 537 lb. per ton in the G.W. engine; the N.E. engine being 498 lb. per ton. Columns 3, 4 and 5 show distinctly the demand made on the G.W. boiler, which is compensated to some extent in Column 6 on the weight ratio basis, the figure of 5.65 lb. being a very low one, even allowing for the difference in engine weights. By adhering to the existing 4–6–0 type, the G.W. designer has combined high power with minimum weight, at the possible expense of boiler power. To approach the G.W. in the 4–6–2 type would mean that the cylinders of the N.E. engine would have to be 19½in. diameter, or the boiler pressure of the G.N. be increased to 190 lb. per square inch, the tractive force then being raised to 31,512 lb. and 31,492 lb. respectively, and, other things remaining as they are, the adhesive factor would be 4.26 in both cases, equivalent to 525 lb. per ton—high enough for a fast-running three-cylinder engine in this country—and the proportion of engine weight to tractive force would be 6.89 lb. for the N.E. and 6.57 lb. for the G.N., with the advantage of a considerably larger boiler than the G.W.

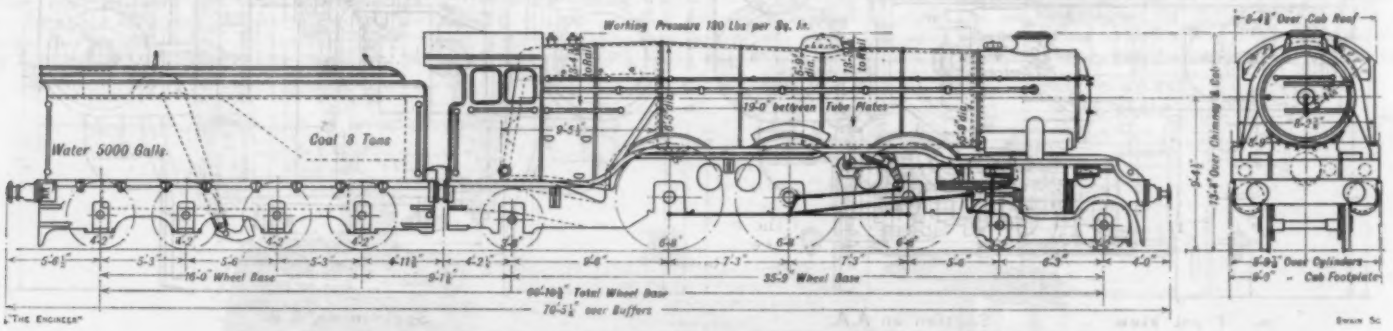


FIG. 84—GREAT NORTHERN—THREE-CYLINDER PACIFIC LOCOMOTIVE "FLYING SCOTSMAN."

Table II.

North-Eastern.	Sq. ft.	Great Northern.	Sq. ft.	Great Western.	Sq. ft.
119 small tubes, 2¼in. o.d.	1472	168 small tubes, 2¼in. o.d.	1880	201 small tubes, 2in. o.d.	1600.04
24 large tubes, 5¼in. o.d.	692.6	32 large tubes, 5¼in. o.d.	835	14 large tubes, 5¼in. o.d.	285.58
Fire-box	200	Fire-box	215	Fire-box	163.76
	2364.6		2930		2049.38
24 superheater elements	509.9	32 superheater elements	525	84 superheater elements	262.62
Total	2874.5	Total	3455	Total	2312.00
Grate area = 41 square feet.		Grate area = 44¼ square feet.		Grate area = 30.28 square feet.	
Ratios.		**Ratios.**		**Ratios.**	
Tubes to fire-box	10.823	Tubes to fire-box	12.67	Tubes to fire-box	11.51
Tubes to grate	52.795	Tubes to grate	61.35	Tubes to grate	62.26
Fire-box to grate	4.87	Fire-box to grate	4.85	Fire-box to grate	5.40
Total heating surface to grate	70.11	Total heating surface to grate	78.06	Total heating surface to grate	76.35
Superheater elements to tubes	23.55	Superheater elements to tubes	19.33	Superheater elements to tubes	13.92
Superheater elements to evaporative surface, per cent.	21.56	Superheater elements to evaporative surface, per cent.	17.91	Superheater elements to evaporative surface, per cent.	12.81
	Sq. ft.		Sq. ft.		Sq. ft.
Evaporative surface per ton of adhesive weight	39.41 (8.51)	Evaporative surface per ton of adhesive weight	48.83 (8.75)	Evaporative surface per ton of adhesive weight	34.82 (4.46)
Total heating surface per ton of adhesive weight	47.90	Total heating surface per ton of adhesive weight	57.58	Total heating surface per ton of adhesive weight	39.28
Evaporative surface per ton of engine weight	24.37 (5.26)	Evaporative surface per ton of engine weight	31.69 (5.68)	Evaporative surface per ton of engine weight	25.66 (3.29)
Total heating surface per ton of engine weight	29.63	Total heating surface per ton of engine weight	37.37	Total heating surface per ton of engine weight	28.95

Comparing the N.E. and G.N. engines only in these last two columns, the figures show a greater demand in the one instance with a decrease in the other, the relative difference being considerably less, obviously, than in the G.W. instance.

Table IV. gives the cylinder volumes and ratios. The volumetric capacity of the N.E. cylinders is 90.06 per cent. and of the G.W. 85.13 per cent. of those of the G.N. The volumetric capacity of the G.W. cylinders is 94.52 per cent. of those of the N.E.

The surface to volume ratio of one cylinder in each instance is .2874 for the N.E., .2769 for the G.N., and .3269 for the G.W., from which may be expected the greater steam consumption per indicated horse-power in the four-cylinder engine.

The difference between Columns 3 and 4 represents the amount of superheater surface available per pound of mean effective pressure per cubic foot of cylinder volume, this being .22 square foot, .19 square foot and .14 square foot respectively; hence the G.W. shows the lowest ratio to the greatest cylinder surface-to-volume ratio, a point which, it would appear, is worthy of investigation on thermo-dynamical lines.

With regard to the boiler pressures these engines are designed for, the various mean effective pressures at any point of cut-off will be reduced *pro rata*, so that the marginal advantage in comparing the engines at maximum cut-off will diminish towards the minimum cut-off, still leaving a slight advantage with the G.W. engine—about 6 per cent. Between the N.E. and G.N. engines the difference is small enough to be practically negligible.

It should be borne in mind, however, that the G.N. boiler is imposingly assessed in total heating surface, practically twenty per cent. over the N.E. and 50 per cent. over the G.W., with almost similar increases in the grate area, and should have ample steam supply to meet the cylinder demand for sustained high-speed up-gradient work, with whatever rated maximum load the engine is given behind the tender. It is the steam-producing capacity of the boiler when running at high speed up continuous gradients, which is, after all, the only true test of locomotive efficiency. In terms of weight, the above increase of heating surface in the G.N. engine has been obtained with a reduction of 4 tons 11 cwt. below that of the N.E. engine, and an increase of 12 tons 12 cwt. above that of the G.W. engine; the latter a very low figure on a comparative basis. Undoubtedly, the saving in weight gained by using high-grade steel in certain parts of the mechanism can be turned to advantage in boiler design, both in cost and material, which is of paramount importance now that engines of these great dimensions are built up "to gauge."

TABLE III.—*Tractive Force and Ratios.*

	1.	2.	3.	4.	5.	6.
	At 85 per cent. boiler pressure.	Adhesive wt. / Tractive force	Tractive force / Evaporative surface.	Tractive force / Total heating surface.	Tractive force / Grate area.	Engine wt. (only) / Tractive force.
	lb.	lb.	lb.	lb.	lb.	lb.
North-Eastern	29,917	4.492	12.652	10.407	729	7.26
Great Northern	29,835	4.504	10.182	8.635	674	6.94
Great Western	31,626	4.168	15.431	13.679	1043	5.65

Tractive Force per Pound Mean Effective Pressure.

	7.	8.	9.	10.	11.	12.
	In cylinders.	Per ton load on driving axle.	Per ton load of adhesive weight.	Per ton load of engine weight.	Per sq. ft. of grate area.	Per sq. ft. of superheating surface.
	lb.	lb.	lb.	lb.	lb.	lb.
North-Eastern	175.98	8.799	2.392	1.813	4.292	2.89
Great Northern	195.00	9.750	3.249	2.109	4.406	2.69
Great Western	165.36	8.394	2.814	2.070	5.461	1.58

TABLE IV.—*Cylinder Volumes and Ratios.*

	1.	2.	3.	4.	5.	6.	7.
	Total cyl. volume.	T.F. per lb. M.E.P. / Cyl. volume.	E.H.S. per lb. M.E.P. / Cyl. volume.	T.H.S. per lb. M.E.P. / Cyl. volume.	Grate / Cyl. volume.	Adhesive wt. / Cyl. volume.	Engine wt. (only) / Cyl. volume.
	Cub. ft.	lb.	Sq. ft.	Sq. ft.	Sq. ft.	Tons.	Tons.
North-Eastern	12.78	13.76	1.05	1.27	3.208	4.09	7.58
Great Northern	14.19	13.74	1.05	1.24	3.118	4.23	6.51
Great Western	12.08	13.68	1.02	1.16	2.506	4.87	6.61

Column 3.—E.H.S. = evaporative heating surface. Column 4.—T.H.S. = total heating surface.

In the tables it will be noted that the equivalent heating surface has not been given, but the ratios so affected can be easily readjusted by adding the usual percentage to the superheat surface. In this connection, the boiler demand factors would work out to 764 for the N.E., 642 for the G.N., and 1041 for the G.W. engines.

The tables offer an interesting and profitable study of the locomotives under comparison, and will indicate a measure of what can be obtained in the conversion of one type to another on a weight and power basis, though it is not inferred that locomotive design is merely an arithmetical rule of simple proportion—far from it. There are certain internal parts, the ratios of which must certainly be considered in connection with heat problems, to produce the best and most efficient results.

GENERAL ENGINEERING EXHIBITS.

RICHARD JOHNSON AND NEPHEW, LIMITED.

Wire is a product which, at first sight, does not appear to lend itself to the arrangement of an attractive display, but it has, nevertheless, been worked up with considerable effect by Richard Johnson and Nephew, Limited, of Manchester. On their stand there are examples of all kinds of steel and copper wire, steel wire coppered, tinned and galvanised, and special classes, such as that used for the manufacture of spring mattresses, which has to be tempered very precisely. There are examples of several manufactured forms of wire, such as cables, ropes and barbed wire. Among the samples of the last named there is barbed wire of comparatively high-carbon steel specially made for export. The material is naturally more costly, weight for weight, but for a given strength it can be made lighter per yard, and this saving, combined with the reduced freight, makes the wire very economical. Another interesting exhibit is a section cut out of the original cables of the Cincinnati Suspension Bridge, which were made by this firm and were taken out of service, after forty years' use, only on account of the increase in the weight of the traffic using the bridge. It is noteworthy that the company also made the wire for the first Niagara Railway Suspension Bridge, which remained in service from 1855 to 1897. On the same stand there are examples of various other products, such as commutator bars, bus-bars and trolley wires.

HUGHES AND LANCASTER, LIMITED.

On the stand of Hughes and Lancaster, Limited, 16, Victoria-street, London, S.W. 1, there is a variety of exhibits, including a large wool-washing machine in motion, but one of the most interesting items is a section of "Bonna" reinforced steel and concrete pipe. These pipes, as our readers are aware, are built up of a sheet steel tube, which is protected, both inside and out, by a shell of reinforced concrete. The standard length is 12ft., and the pipes are made in diameters ranging from 12in. up to 90in. One of the most valuable features claimed for these pipes is that they can be made on temporary premises near to the line of the aqueduct, with the result that transport difficulties are minimised, while there is less liability for the pipes to be cracked in transit than there is when they have to be moved over long distances after they are cast.

The first stage in making a pipe is to roll the sheet steel core into a cylinder and butt weld the edges by the oxy-acetylene blowpipe. The reinforcement, which is then built up outside, comprises a series of longitudinal steel bars of a special cruciform section, and a set of bands of the same material. The thickness of the plate and the amount of reinforcement are so proportioned as to withstand the whole of the bursting stresses on the pipe. The engraving Fig. 86 gives a good impression of the plate core with the reinforcement in place. Inside the pipe there is built up another cage of reinforcement, but as its only duty is to hold the lining of concrete in place, it is of lighter section.

When the steel skeleton is ready for pouring it is set on end on a base mould, a core is placed inside and an external mould bolted on outside. The cement concrete, which is made of aggregate which must pass a $^{3}/_{16}$in. screen, is then poured simultaneously for the inside and outside layers. Arrangements have, however, recently been developed for placing the interior concrete centrifugally, and in this connection it is interesting to note that it has been found that the concrete is compacted to less than

FIG. 85—A COMPLETED "BONNA" PIPE

half its bulk in the dry state by the centrifugal force. It is, in fact, necessary to supply 120 per cent. more of dry gauged material than the calculated volume of the lining, to make up for the increase in density.

At one time, when some of these pipes were being made in cold weather, it was deemed advisable to keep them warm during setting, so they were covered with canvas hoods and wet steam was led into the interior. The results were so satisfactory that the process is now always adopted regardless of the weather. All pipes are steamed and the forms can then be taken off within a few hours of casting, while any tendency for the concrete to crack has been eliminated. Fig. 85 is from a photograph of a completed pipe, and shows the absence of any cracking.

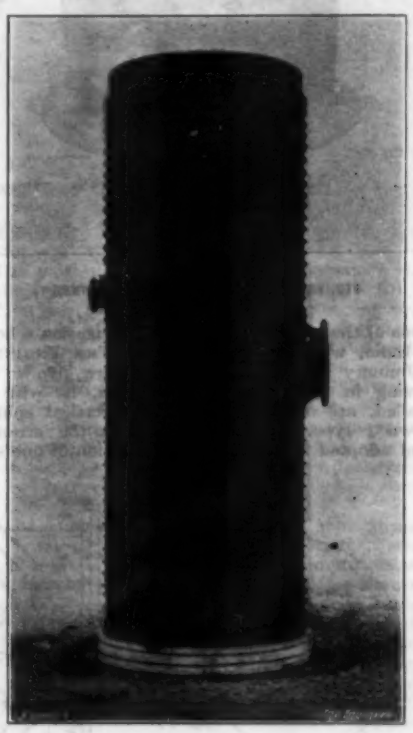


FIG. 86—CORE AND EXTERIOR REINFORCEMENT

The joints between the lengths of pipe are made by setting a steel band round the abutment of the

sheet steel cores and caulking with hemp and lead pipe filled with tarred yarn. A reinforced steel ring, about 1in. larger in internal diameter than the outside of the pipe, is then put in place, and the whole surrounded with concrete. Finally, the joint is pointed with cement mortar from the inside, so as to make the surface flush throughout. Fig. 87 shows a 60in. "Bonna" main jointed up in its trench.

FIG. 87—60-INCH "BONNA" MAIN IN TRENCH

These pipes have been adopted for several important waterworks schemes, and have been used for pressures of up to nearly 400ft. head of water.

GWYNNES ENGINEERING COMPANY, LIMITED.

The most noteworthy exhibit on the stand of Gwynnes Engineering Company, of Hammersmith,

FIG. 88—IRRIGATION PUMP—GWYNNES

is one of the pumps for the Renala irrigation scheme in India, which was described in THE ENGINEER of January 11th, and of which we now give an engraving in Fig. 88. These pumps, it will be recalled, are of the double inlet, vertical spindle drowned type, and are peculiar in the arrangement adopted for preventing the suction of one side of the impeller interfering with that of the other side. The lower eye of the impeller draws its water through the bell mouth, which can be seen depending from the main casing, while the supply to the top of the runner is conducted up through channels cored out in the casing between the guide passages. These channels appear as columns supporting the upper part of the pump in the engraving—Fig. 88. The result is that the two streams of water flowing into the pump are quite distinct, and one does not interfere with the other, while the passages can be so proportioned that some of the weight of the revolving parts can be taken hydraulically, to the corresponding relief of the footstep bearing. The pump at Wembley is erected in a well, as it will be in India, and part of the brickwork is cut away so that it can be seen plainly. This pump is one of eight which are now being shipped to India. The group comprises six, each capable of delivering 22,500 gallons per minute against a head of 8.5ft., and two sets for 18,750 gallons per minute against the same head. They are to be driven through machine-cut gearing by vertical spindle alternating-current motors. The advantages claimed for these pumps are that they are small, by comparison with their output, low in cost, are adaptable for driving by high-speed motors, and require no pipe connections.

Among the other items on this stand there is one of the rotary sewage traps, described in THE ENGINEER of March 16th, 1923, which enable centrifugal pumps to be used for handling water containing so much solid matter that it would otherwise choke the pump. The essential parts of the trap are shown in Fig. 90, while the drawing—Fig. 89—shows the general arrangement of the machine. The trap is arranged in parallel with the pump, and its function is to separate out all large solids from the water and pass them directly from the suction to the delivery without their going through the pump itself, while the liquid alone is handled by the pump. It thus becomes possible to deal with water containing any solids, so long as they are of such a size that they will pass through the suction branch.

The trap comprises a set of radial arms which are slowly rotated inside a cylindrical casing by a small electric motor. The sides of the arms are covered with a series of rings that form a grid which will not pass any solid matter that might be detrimental to the pump impeller. Passages are cored in the casing in such a manner that the water on its way to the pump is sucked through this grid from the inside outwards. The result is that the solids are left behind, between the rotating arms, and are pushed forward round the casing. Further on round the circumference the discharge from the pump is led into the trap again and passes through the grid in the opposite direction, sweeping the solids out of the pockets between the arms into the outlet. Provision is made so that in the event of such material as a piece of rope being drawn into the trap, it is chopped up into pieces and does not clog the mechanism. We understand that since we last noticed this device at least eight sets have been made and put into service with entirely satisfactory results.

There are also on this stand a multi-stage pressure pump for bunkering motor ships, a small fire pump, a steam turbine-driven boiler feed pump, and the emergency bilge pump, shown in Fig. 91. The pump itself is of the normal, single inlet, self-clearing type, and has the suction above, so that the weight on the spindle is partially relieved. It is driven by a motor, generally of the direct-current type, in a water-tight casing. The gland through which the spindle passes is subject to the slight vacuum of the pump suction, with the result that there is no liability for water to leak into the motor casing.

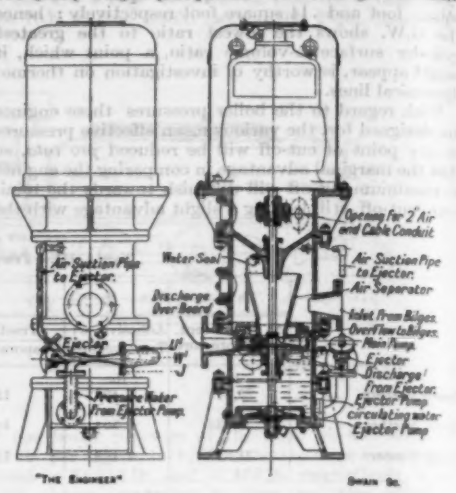


FIG. 91—EMERGENCY BILGE PUMP—GWYNNES

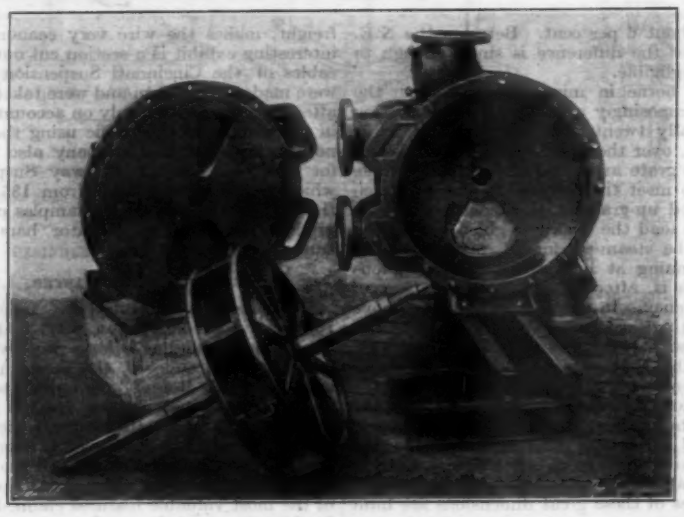


FIG. 90—THE GWYNNE-PENNELL ROTARY TRAP

For the purposes of priming, an air pump has been discarded, as being too unreliable, and its place is taken by an ejector. This ejector is worked by a stream of water delivered by a small impeller on the extreme lower end of the pump spindle. A reservoir of water is provided directly above this pump, and the water is circulated round and round,

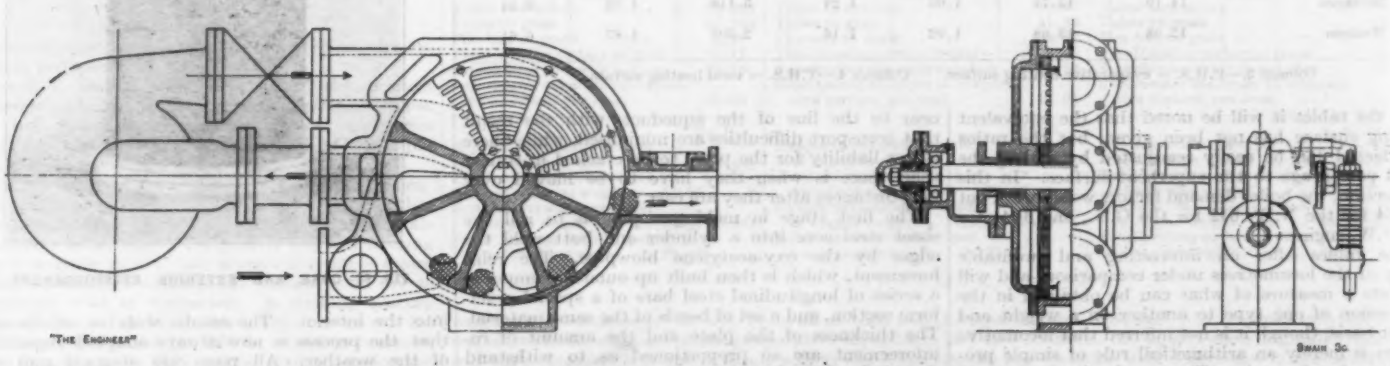


FIG. 89—ARRANGEMENT OF THE GWYNNE-PENNELL ROTARY TRAP

so that the ejector can go on working until the main pump draws. It will be readily appreciated that the whole arrangement is very unlikely to get out of order, and is always ready to start up at a

1500 K.W. TURBO-GENERATOR—ENGLISH ELECTRIC COMPANY

FIG. 92

moment's notice. The pump is made in three standard sizes for 100, 150 and 200 tons per hour.

ELECTRICAL ENGINEERING EXHIBITS.

English Electric Company.

As we stated in the article on the Exhibition power-house, published in our issue of March 7th, the English Electric Company was responsible for the construction of one of the turbo-generating sets. This set, a duplicate of which is shown in Fig. 92, is capable of developing 1500 kilowatts at a pressure of 3300 volts, and it runs at a speed of 3000 revolutions per minute. A surface condenser with a cooling surface of 2800 square feet was also built by the firm for use in conjunction with the generating unit. In the sub-station the company has installed a 500-kilowatt rotary converter, which is started on the transformer tapping principle. The converter is fitted with a brush-lifting device for use during the starting period, and the armature runs in roller bearings. On the company's stand there is also a 1000-kilowatt rotary converter, as shown in Fig. 93, the speed of which is 750 revolutions per minute with a pressure on the direct-current side of 440/575 volts.

The three-phase 50-cycle transformer—shown in Fig. 94—is another of the company's exhibits. It will be seen that the transformer has a tubulous tank with rounded ends. The output is 634 kilovolt-ampères. Various other transformers are on view, including a 200 kilovolt-ampère 3300/440-volt 50-cycle mining transformer and a transformer designed for mounting on a pole. Among the motor exhibits is an asynchronous-synchronous machine suitable for directly coupling to a compressor. The machine is rated at 170 horse-power, at a speed of 187 revolutions per minute, and it is wound for three-phase 50-cycle current and for a pressure of 415 volts. It is fitted with an exciter, which enables the motor to run at unity power factor at full load. A selection of standard direct-current and alternating-current motors rated at 5 horse-power and upwards is also shown.

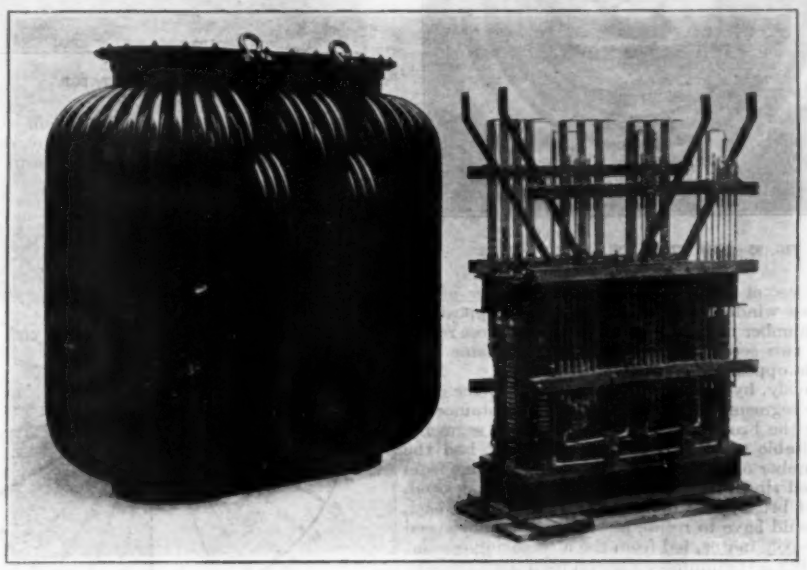


FIG. 94—634 K.V.A. THREE-PHASE TRANSFORMER—ENGLISH ELECTRIC COMPANY

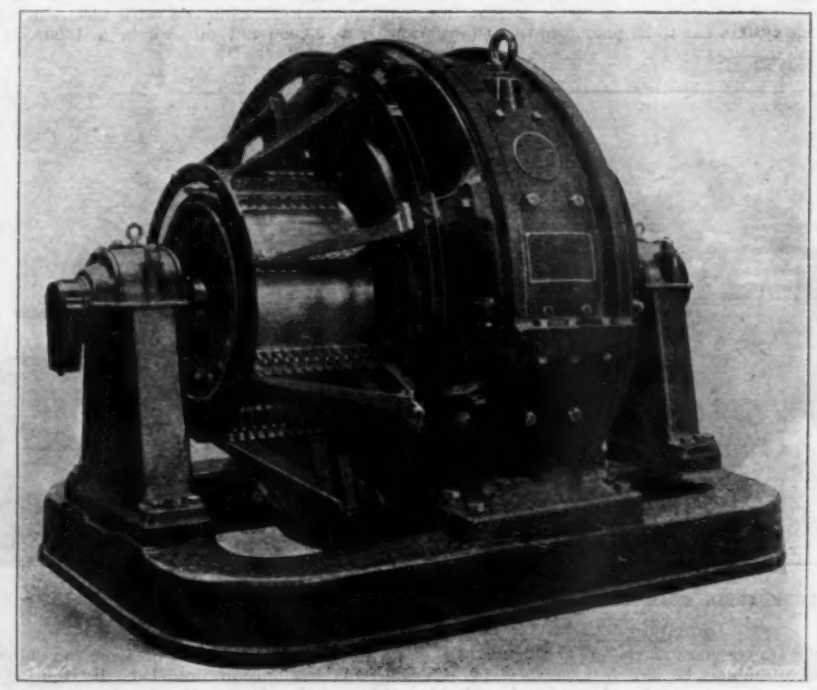


FIG. 93—1000 K.W. ROTARY CONVERTER—ENGLISH ELECTRIC COMPANY

The most novel exhibit on the company's stand is the transverter, which is shown in Figs. 101 and 102, on page 535. It is an arrangement for converting three-phase alternating current into direct current, or *vice versâ*. Alternating current at the station bus-bars at a pressure of, say, 6000 or 11,000 volts, can be converted into 100,000 volts direct current for transmission, whilst at the distributing end of the line transverters can be employed for re-converting to alternating current at a suitable pressure. By providing a second set of commutators, transverters can be arranged to provide 1500 or 3000-volt current for railway work.

Voltage transformation and phase multiplication are carried out by static transformers, whilst rectification is performed by ten commutators with fixed segments and revolving brushes, as shown in Figs. 95, 96 and 97. As regards phase multiplication, the object to be aimed at is to produce a number of elements having phase positions uniformly spaced, so that they may be joined in series to produce a completely closed winding, like that of a gramme ring armature, from which uniformly spaced tappings may be taken off to the commutator segments. Suppose that the primary of a three-phase transformer deals with one of the fundamental phases, and that each core carries two secondaries, also that the connections of one set of each of these windings are reversed so that there are six secondary phases spaced 60 electrical degrees apart. If, then, another transformer has on each of its cores primary windings for two of the fundamental phases, the flux in each core will be out of phase with the flux in the corresponding core of the first transformer, and by putting two secondary windings on each core of this second transformer, another set of six equally spaced phases can be produced, and their phase positions will be between those of the first six phases. Obviously,

by continuing this process any number of phases that are a multiple of six can be produced, and the angular displacement between adjacent secondary phases may be made uniform.

From three primary phases, which may be represented by three vectors, 120 deg. apart, a secondary phase system may be developed, consisting of some multiple of six phases, which can also be represented vectorially by radiating lines with a uniform angle between them, the actual value of the angle being 60 divided by the whole number. A closed-mesh winding on the primary side would be represented by a triangle, and a similar winding on the secondary side as a polygon, the number of sides being some multiple of six. The diagram—Fig. 98—shows the rotating vectors which represent the transformer induced electromotive forces, assuming there are eighteen magnetic cores, with two secondary windings on each, one being connected in the reverse direction to the other. Consequently there are thirty-six separate phases spaced 10 electrical degrees apart.

Any of these vectors when projected on to the vertical line will, of course, give the instantaneous value of the induced electromotive force at the particular instant considered. The number at the point

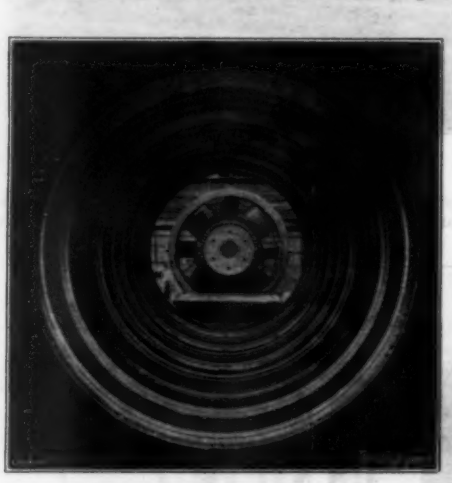


FIG. 95—END VIEW OF COMMUTATORS

of each vector represents the phase number of the secondary winding, and each number is opposite a similar number marked with the letter A, these representing two secondary windings on the same core wound in opposite directions.

Obviously, by connecting the tappings to the commutator segments, direct current can be obtained by rotating the brushes over the commutator segments at a suitable speed. If each commutator had the same number of segments as there are tappings from the closed ring winding, with which it is associated, a pair of brush arms diametrically opposite to each other would have to rotate at the synchronous speed of a two-pole motor, fed from the alternating-current supply, but a commutator may be used with twice or three times as many segments as there are tappings. Each tapping is connected to two or three segments spaced uniformly around the commutator, and the speed of rotation then corresponds to that of a four-pole or six-pole motor, the spacing of the brushes around the commutator being changed accordingly. As we have said, the high-tension direct-current voltage is divided up on ten commutators, which are

say, a railway at another pressure. In this case there is a second closed winding system on the transformers, and this winding system is connected to commutating

FIG. 97—COMMUTATOR

gear similar to that used at the input side of the machine. One winding system receives energy and the other delivers energy. Another use to which the

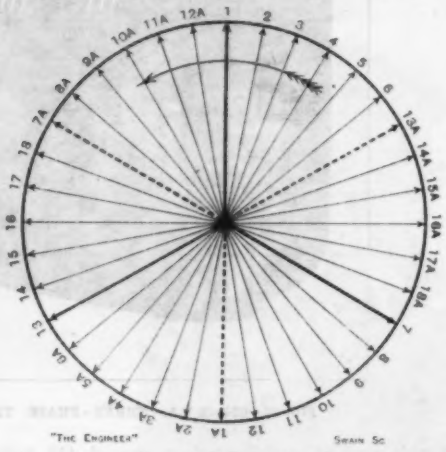


FIG. 98—VOLTAGE DIAGRAM

transverter can be put is that of linking up alternating-current systems by means of a direct-current line. If a 25-cycle system has to be linked up to a 50-cycle

wireless transmission work, especially in high power stations. The curve—Fig. 100—shows the direct current to alternating current efficiency of a 2000-kilowatt transverter as shown at the Exhibition. For a transverter used for transforming high-pressure

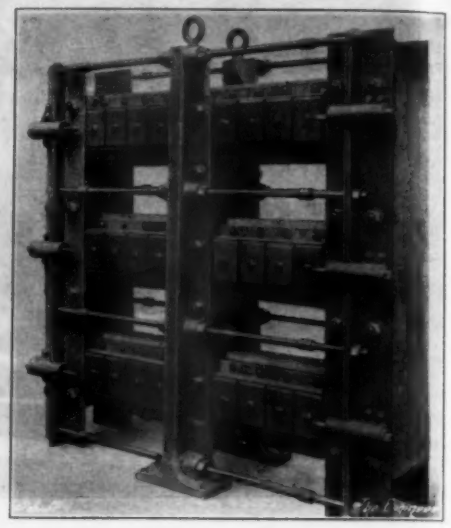


FIG. 99—SIX-PHASE TRANSFORMER CORE

direct current into direct current at a lower pressure, the efficiency would, of course, be somewhat lower, but what the actual figure is we are not in a position to say. The machine at Wembley, which is shown in the various illustrations to which we have alluded, gives 20 ampères at 100,000 volts when fed with

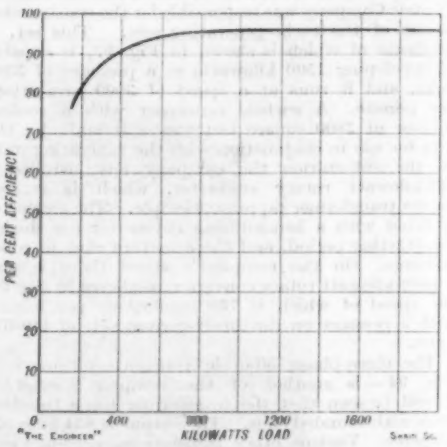


FIG. 100—EFFICIENCY CURVE

50-cycle three-phase 6600-volt current, and it runs at a speed of 1000 revolutions per minute.

Switchgear exhibits consist of a truck type unit designed for a pressure of 6600 volts, a 20,000-volt oil switch, complete with electrical operating gear, a 33,000-volt oil switch, a 1500-volt direct-current traction circuit breaker, an alternating-current low-tension ironclad distribution board, with a main oil switch, an auto-transformer ironclad starting unit, a starting unit with an oil-immersed

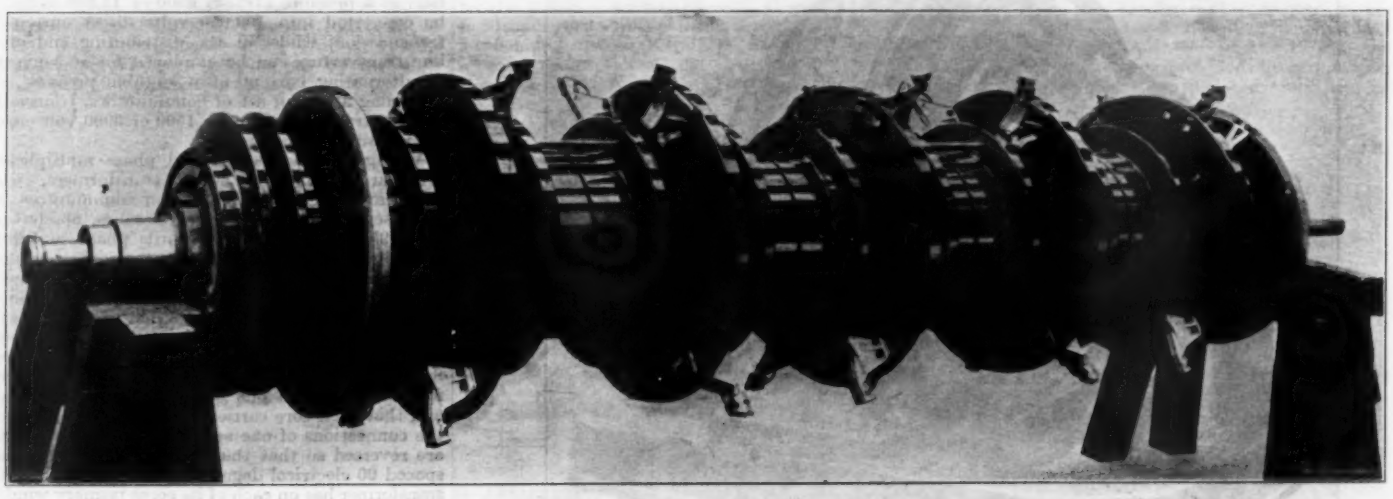


FIG. 96—REVOLVING BRUSH GEAR—ENGLISH ELECTRIC COMPANY

connected in series. There are three six-phase transformers with cores of the type shown in Fig. 99.

The transverter may also be designed to receive direct current at one pressure and to supply it to, system, the transverters at the opposite ends of the line would, of course, be designed for these periodicities. The transverter is also claimed to be suitable for providing the high-tension current necessary for

2000 KILOWATT ELECTRIC TRANSVERTER

THE ENGLISH ELECTRIC COMPANY, LIMITED, LONDON, ENGINEERS

(*For description see opposite page.*)

FIG. 101—THE MACHINE IN COURSE OF ERECTION

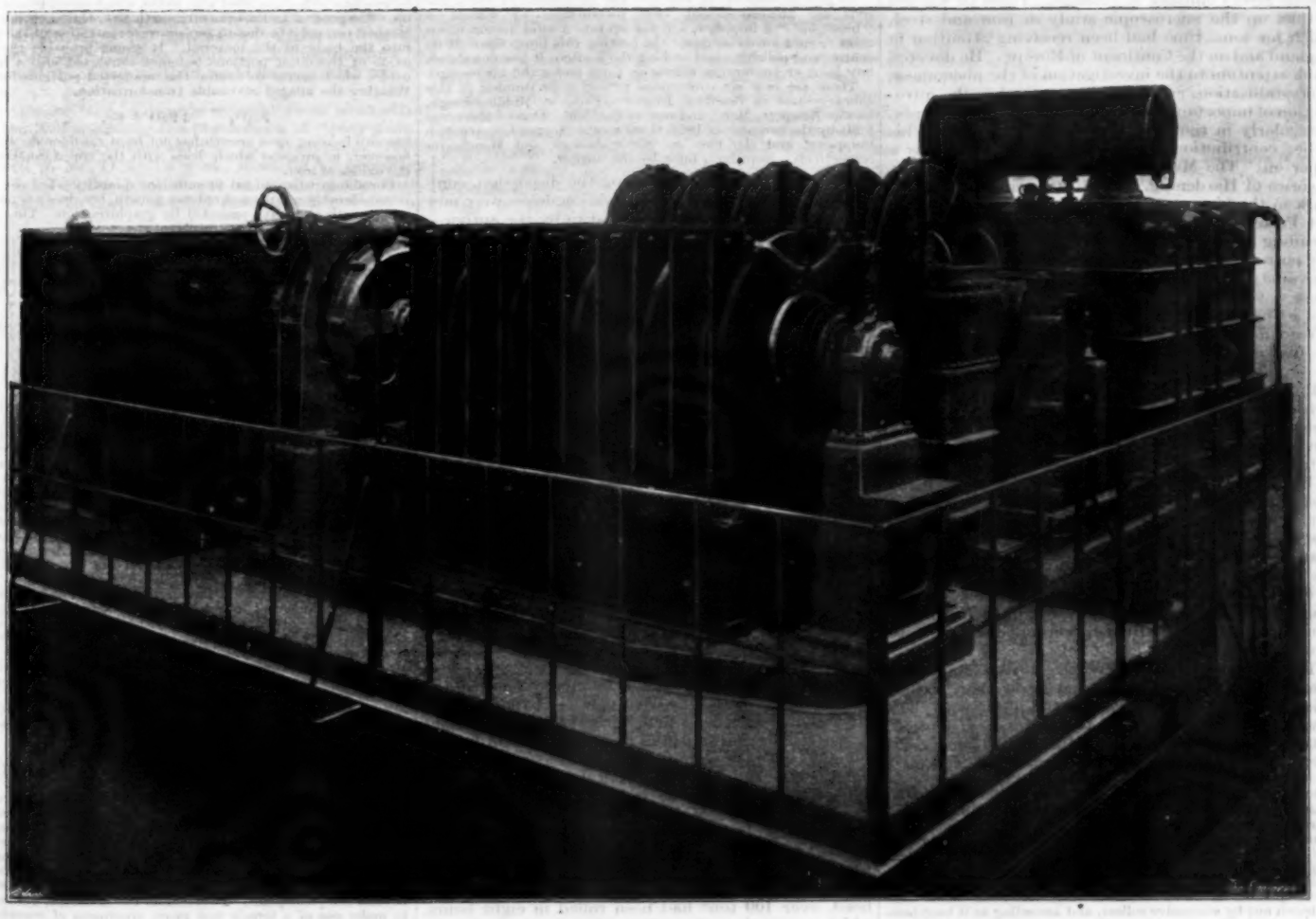


FIG. 102—THE COMPLETED MACHINE AS EXHIBITED

rotor starter, and a liquid starter of the pot type.

The company's oil switches are designed for heavy duty, and the construction is of a particularly robust and substantial character. Each switch is a separate self-contained single-phase unit with its own tank and operating shaft. The units are coupled together by special couplings which allow smooth and satisfactory working, even when not perfectly in line. Switches are standardised in a number of sizes suitable for pressures up to 33,000 volts and rupturing capacities up to 1¼ millions of kilovolt-ampères. The usual method of operation is by electric solenoid, which is also a self-contained unit embodying tripping gear and free handle device. By this means the switch is free to open automatically immediately the contacts touch and independently of the closing operation, thus making it impossible to hold the contacts closed or partially closed against the action of the trip coils. If the oil switch should trip in the act of closing it is necessary first to bring the operating handle back into its normal position before another closing movement can be initiated.

Iron and Steel Institute.

No. I.

ANNUAL MEETING.

There was a good attendance at the annual meeting of the Iron and Steel Institute, which was held in the house of the Institution of Civil Engineers on May 8th and 9th, under the presidency of Sir William Ellis.

It was announced that Mr. Gustave Trasenster had been elected an honorary vice-president and that Dr. H. C. H. Carpenter and Mr. C. Markham had been elected members of Council. All the retiring vice-presidents, Lord Airedale, Sir Frederick Mills, and Sir W. Peter Rylands, and the following retiring members of Council, Mr. W. R. Lysaght, Colonel Sir W. Charles Wright, Dr. J. O. Arnold, Mr. F. W. Harbord, and Mr. A. Hutchinson were re-elected.

The President then delivered an address, of which we gave a long abridgment in our last issue.

Bessemer Medal.

In presenting the Bessemer Medal to Professor Albert Sauveur, the President said that the recipient, who was born in Belgium in 1863, was originally a student of the School of Mines at Liége and afterwards studied at the Massachusetts Institute of Technology, where he completed his scientific training, and obtained in 1889 the degree of Bachelor of Science in Mining and Metallurgy. Immediately afterwards he entered the service of the Pennsylvania Steel Company as chemist, but left the following year, 1890, to take charge of the research laboratory of the Illinois Steel Company at Chicago. There he was led to take up the microscopic study of iron and steel, which for some time had been receiving attention in England and on the Continent of Europe. He devoted much attention to the investigation of the phenomena of crystallisation, and his work resulted in the introduction of important modifications and improvements, particularly in the rolling of rail steel. Among his earlier contributions to technical institutions was a paper on "The Microstructure of Steel and Current Theories of Hardening," which still remained a landmark in the history of heat treatment, in which subject Professor Sauveur had since been recognised as a leading authority. Since the year 1905 he had held the position of Professor of Metallurgy at Harvard University. He was awarded in 1913 the Elliott Cresson Gold Medal of the Franklin Institute, and was a Chevalier of the Legion of Honour and Officier d'Academie. From 1917 to 1919 he was director of the division of metallurgy in the technical section of the air service of the American Expeditionary Force.

Professor Sauveur, in acknowledging the presentation, expressed his gratification at having his name added to the roll, to which, including himself, only six workers in America had been admitted. They were Peter Cooper, in 1879; Alexander Lyman Holley, in 1882; Abram S. Hewitt, 1890; John Fritz, 1893; and Henry Marion Howe, in 1895. The fact that twenty-nine years had elapsed since the medal was bestowed on an American metallurgist suggested that, while those engaged in the American branch of the iron and steel industry had given great attention to questions connected with production, they had not done their share in the advancement of the science of metallurgy to which British workers had given so much attention.

The meeting then proceeded with a somewhat heavy programme of papers, no fewer than sixteen being on the agenda for reading and discussion. The first paper presented was that by Mr. J. P. Bedson, entitled "Continuous Rolling Mills, their Growth and Development."

CONTINUOUS ROLLING MILLS.

George Bedson, general manager of Richard and William Johnson Brothers, Manchester, conceived the idea of continuous rolling. He obtained a patent, dated July 2nd, 1862, in which he claims "the employment of a series of 'rolls' placed at varying angles, whereby the necessity of turning the metal is avoided." The idea of a continuous system was suggested to him by the drawing frame in cotton manufacturing, where the cotton fibre is drawn out by successive rollers, and according as it lengthens at each draft, the succeeding roller runs at an increased speed. In 1862 his first continuous wire rod rolling mill was built, and to avoid all works prejudices and also to test the machine, it was erected in an old silk mill in the Adelphi, Salford, Manchester, with furnace and engine complete. It ran with such success that the inventor was encouraged to find room for it, and erected it permanently at Bradford Ironworks, Manchester, where it remained continuously in operation until 1884.

To get the rolls running at various speeds to take up the rod as it passed from one pair to another was comparatively simple. But to ensure its safe passage through the necessary intervening guide was quite another matter. However, with time and patience this was ultimately accomplished, and to-day the guides remain in principle much as the inventor left them. It is of interest to note that on investigating the question of patenting the Bedson rolling mill in America, it was revealed that substantially the same idea had been patented in the United States of America by Joseph S. Levy (1854) and Henry B. Comer (1859), but neither had ever constructed a mill on their principle.

From the 'nineties onwards the invention underwent its full and natural development in the United States of America, where to-day 30 per cent. of the rolled products are rolled on the continuous system. Little or nothing was done in this country with the system outside the Bradford Ironworks; but in 1884 La Société Anonyme de Commentry Fourchambault, Nièvre, France, ordered a mill similar to the 1866 mill, to run on a royalty, and it was built at Bradford Ironworks, under the direction of the author. The company did not, however, make a success of it, although it did roll as much as 12,000 kilos. of 4 mm. (11.8 tons of No. 8) in a single shift, out of the most beautifully soft material. This was the first continuous mill to run in France. The author demonstrated at those works that it was possible to roll a billet direct from an ingot, and with the initial heat to finish it into a No. 8 wire rod. This was in October, 1885. Mr. Bedson died before this mill was finished, on December 12th, 1884, at the age of sixty-four.

In 1887 Mr. Charles H. Morgan severed his connection with the Washburn Moen Manufacturing Company, and thereafter devoted himself to the development of the continuous rolling mill system, not only for wire rods, but for billets, bars, hoops, flats and other sections, where quantity and length were called for in the ordinary run of merchant mill practice. His first type was a straight continuous wire rod mill, in which he adopted the 1¾in. billet, 30ft. long, weighing 300 lb. His company has supplied about fifteen of these mills, of which one was for a Paris firm—the first of its kind on the Continent of Europe—and from that mill much of the continuous system of rolling has been copied.

In 1893 the author designed a wholly continuous wire rod rolling mill for the Bedson Wire Company, Limited, Middlesbrough, since absorbed by Dorman, Long and Co., Limited, and there the 2in. billet was adopted in a 28ft. length, weighing 364 lb., so that, as required by some wire-drawers and others who cannot take such long pieces, the resultant rod can be cut into three equal parts of 1 cwt. each, a weight commonly called for in the wire trade.

In 1916 Richard Johnson and Nephew, Limited, Manchester, decided to put down another continuous wire rod rolling mill within a few yards of where the first was erected. This was built during the war from the designs and under the direction of the author. Again, the Morgan principle of all horizontal rolls was adopted. The mill consisted of three continuous trains of rolls of 12in. diameter. First, the roughing mill with eleven pairs of rolls, for rolling two 2in. billets at a time, and driven by an electric motor of 2750 horse-power. Secondly, two continuous finishing mills with 12in. rolls, each taking one of the resultant products of the roughing mill and finishing to No. 6 standard wire gauge in five passes, thus making sixteen passes in all. Each of these finishing mills is driven by a 750 horse-power motor, and the three motors are taking the full alternating current of 6600 volts direct from the Manchester Corporation mains. The running of the mill is controlled by a push-button device operated by an attendant. The speed of the mill is such that it takes one minute to reduce a 2in. square billet, 28ft. long, weighing 364 lb., to a wire rod. The capacity of the mill under present labour conditions of three shifts of 7½ hours each is 1250 tons a week.

To give an idea of the effect of the high speed at which the rods are finished—about 1000 revolutions per minute—a "break-out," if impeded, will run up into a solid homogeneous mass from a small section. On cutting this lump through its centre, and polishing and etching the section, it has not shown any joint or lamination whatever, even under the microscope.

There are now six continuous rolling mills running in this country—two at Bradford Ironworks, one at Middlesbrough, two at Newport, Mon., and one at Sheffield. One of them was built by the inventor in 1866, three by the Morgan Construction Company, and the two—at Middlesbrough and Manchester respectively—were both built by the author.

Mr. L. P. Whitehead, opening the discussion, commented on the fact that American engineers were now going back to the system referred to by the author—the old Staffordshire wobbler method, which in a continuous mill was far and away the best. He had been responsible for the introduction of a mill to produce rods, bars, and strip which had been running since 1907. It was designed to work on any section from $^{3}/_{16}$in. to 1¾in., which was practically the whole range of rods, and could deal with heats from ¾in. to 3in. in strip. There was no other continuous mill at work in Great Britain with such a wide range of sizes. A point he would emphasise was that no continuous mill could prove a success if it was erected at an inland works. It must be on the coast, so that full advantage could be taken of the export trade.

Signor Falck, who addressed the meeting in French, said the question of erecting continuous mills had received consideration in Italy, but one difficulty arose from the fact that very few works had cogging rolls for making billets from the ingots, and the question had arisen whether it would not be possible to start from the ingot. In Silesia he had seen in operation continuous rolls starting on 7in. ingots, and it would appear that the problem had been solved.

Mr. T. W. Hand, referring to the statement in the paper that in America 30 per cent. of the rolled products were rolled on the continuous system, said it would be interesting to have details of that output. He had noted during a tour in the United States that it was the custom to install a continuous mill in conjunction with a cogging mill, and 80 per cent. of all billets were rolled on the continuous system. He agreed that it might be possible to roll wire rods direct from the ingot, but questioned whether it was worth while. It was a question for argument whether the continuous mill or the auxiliaries of the mill were the more important. At the mill at Newport (Mon.), which had been mentioned by Mr. Whitehead, over 100 tons had been rolled in eight hours, which meant that about 200 miles of strip had to be disposed of, and without adequate auxiliary plant it would be impossible to handle that quantity of material. The author was wrong in stating that there were only six continuous rolling mills at work in Great Britain. There were four at work in Staffordshire alone, and he believed there were twelve in all. A very large number were at work in the United States. There would appear to be scope for additions to continuous rolling mill equipment in British iron and steel works, and that the result would be a reduction in the cost of producing billets.

Mr. John Ellis said that the rolling of wire rods direct from the ingot was being done at a small steel works in Libau, where about 300 tons of wire rods per week were being produced. The ingots were cast on the hen and chickens principle, and were put through a continuous heating furnace into an ordinary cogging mill and thence through shears direct to a three-rod looping mill.

Mr. Bedson, in reply to the discussion, said that he had seen two mills in Germany in which an ingot could be rolled into a bloom and was then passed into a continuous mill, rolled into billets, and put through the looping mill in six strands. The process was claimed to have achieved success. Perhaps the game was not worth the candle or good commercial practice, but he had himself shown it to be possible to roll an ingot from the initial slab down to No. 8 rod. He agreed with what had been said as to the importance of the auxiliary equipment of a continuous rolling mill plant. He was glad to hear that the number of mills in Great Britain rolling on the continuous system was larger than he had stated, as one of his reasons for bringing the subject before the Institute was that the subject of continuous rolling was not receiving the attention it deserved, particularly having regard to the advances in this field being made in other countries, notably Germany.

The second paper on the agenda was that by Messrs. J. H. Andrew and H. Hyman, "High Temperature Growth of Special Cast Irons," which, in the absence of the authors, was taken as read. There was no discussion.

GROWTH OF SPECIAL CAST IRONS.

The types of growth curves obtained by heating grey and white irons fifty times to 900 deg. Cent. are similar in all respects to those obtained by Carpenter and Rugan and Carpenter. Nickel and aluminium, when added in sufficient quantities, bring about growth in a manner similar to that brought about by excess of silicon. It is suggested that these elements—nickel and aluminium—increase the ultimate growth and rate of growth, not because of their being highly oxidisable metals—nickel being less oxidisable than either iron or any of the special elements added—but rather because they produce a coarsening effect upon the graphite. The graphite flakes becoming more bulky, provide wider and deeper channels for the easier penetration of air.

Growth in grey irons takes place in two definite stages, as found by Carpenter, the first or rapid stage being brought about by oxidation of the ferrite, the carbon being at first but slightly oxidised. When sufficient oxide has been formed, carbon then becomes oxidised, causing the entire channels previously occupied by graphite to become filled with oxide, which serves to seal them up. The gradual and continued growth after this stage has been reached can only be due to the slower penetration of the oxide into the body of the material. It seems probable that the oxide at the outer portions becomes converted into a higher oxide, which serves to oxidise the unaffected portions further. Whether the alleged reversible transformation,

$$Fe_3O_4 \rightleftarrows 3\,FeO + Fe,$$

has any bearing upon growth has not been considered; work is, however, in progress which deals with the transformations of the oxides of iron.

Chromium when added in sufficient quantity—1.5 per cent.—considerably retards and reduces growth, but does not prevent it. Growth is always preceded by graphitisation. This again agrees with the deductions of Carpenter.

At the afternoon meeting on May 8th a long discussion took place on the papers by Dr. F. C. Thompson and Mr. W. E. W. Millington, "The Plastic Deformation of α and γ Iron," and that by Mr. Hugh O'Neill, "The Effect of Cold Work upon the Density of α Iron."

PLASTIC DEFORMATION OF IRON.

The X-ray work of Westgren is the basis on which the authors have endeavoured to build up their ideas, and brief reference to it is required. In the cube-centred crystal of α-iron there are in each unit cube nine atoms, of which one is at the centre and the other eight at the cube corners and touching the central atom. Each atom is therefore in contact with eight similar atoms, and it may readily be shown that the plane on which the atoms are most densely packed is that of the rhombic dodecahedron. In the case of γ-iron, the packing is face-centred, or the closest possible. The unit cube contains an atom at each corner, and one at the centre of each face. Any atom is in contact with twelve others, and the face of closest packing is that of the octahedron. From ping-pong balls, or the more accurate ones used in ball bearings, it is possible to build up structures which are in many way analogous to the space-lattices. Assuming the atoms to be hard spherical bodies—an assumption which, though not strictly correct, still leads to results of value—it is possible to examine the behaviour of the structure under stress, and to predict the changes which will ensue in the crystal itself. This is especially the case when the mutual atomic attractions are taken into consideration, as to some extent they may be, with the result that it has been possible to delve more deeply into the behaviour of the metal than has hitherto been found possible.

EFFECT OF COLD WORK UPON CRYSTALS OF IRON.

Determinations of the density of α-iron subjected to increasing amounts of cold work were undertaken, because of their bearing upon some theoretical considerations published in another paper presented at this meeting of the Iron and Steel Institute by Professor Thompson and Mr. Millington. These authors were particularly interested in the density of an aggregate of iron crystals which had been stressed to small amounts just beyond the yield point. To elucidate the matter, it was decided to make use of a tensile test piece, specimens of considerable weight yet having undergone only small increments of cold work

being obtained in this way. Densities were measured by the ordinary methods of weighing in air and weighing in water. When this set of determinations had just been completed, the Metropolitan-Vickers Electrical Company, Limited, of Manchester, through Professor W. L. Bragg, kindly supplied the Department with some large single crystals of vacuum-melted iron, thus making it possible to study the behaviour of a single crystal in comparison with that of an aggregate of somewhat similar material.

If an aggregate of crystals of α-iron be increasingly cold worked in tension the mean density, whilst at first showing but small alteration, soon decreases by about 0.17 per cent. It then appears that a critical amount of deformation is reached at which the density ceases to fall, and may rise slightly. With further increments of cold work the density decreases. When cold-worked iron is annealed at about 650 deg. Cent., a marked crystalline growth takes place. Sauveur found with regard to this phenomenon that there was a critical amount of cold work which favoured a maximum grain size. In a steel* containing 0.05 per cent. carbon with a maximum stress of 45,600 lb (20.8 tons) per square inch, this critical deformation was produced by a tensile stress of 40,000 lb (17.8 tons) per square inch, which is about 88 per cent. of the maximum. Chappell's test pieces of Swedish iron, with a maximum stress of 21 tons per square inch, showed that a particularly large grain size was obtained on annealing where the stress had averaged about 17 tons per square inch. This stress corresponds with about 80 per cent. of the maximum.

The variation in density of the single crystal, as it is deformed in the cold, presents a striking contrast to that of the Armco aggregate. After 26 per cent. reduction by compression, the density has only decreased by 0.07 per cent., and with further working it actually rises above its original value. The slipping appeared to take place principally along the rhombic-dodecahedral (011) plane.

Dr. Walter Rosenhain said the theory put forward in Messrs. Thompson and Millington's paper had been brought up at the recent meeting of the Institute of Metals. It was then promised that a large amount of experimental evidence in support of the theory would be available in the near future. If the paper presented that day was to be regarded as a fulfilment of that promise, the evidence adduced was quite insufficient to substantiate the theory. He strongly deprecated atoms being regarded as spheres, except as a mental exercise. It had been shown mathematically that if atoms having a uniform field of attraction and repulsion were piled up they did not possess rigidity. It was necessary to assume that the atom possessed a directional property, and once that fact was admitted any conclusions based on the analogy of smooth spheres must be rejected.

Colonel N. T. Belaiew said he thought it could be shown that some of the deductions made by the authors could be reconciled with the facts. Most, if not all, the deductions made by the authors could be reached by other means. The models were only used to enable other workers to follow more closely, than would otherwise be the case, conclusions which were put forward on micrographical and crystallographic grounds. There was the question whether a further step could be taken and whether, from the idea that atoms behaved like the spheres used in the experiments, geometrical and other conclusions could be drawn. The idea that atoms were in the nature of spheres was a very old one, and on it was built up the kinetic theory of gases. Speculations of the character indulged in by the authors were used by chemists and physicists of good repute. It was desirable, however, that experiments should be made to test the soundness of the conclusions put forward in the paper by Dr. Thompson and Mr. Millington, and he believed the X-ray method could be used with advantage.

Professor C. A. Edwards thought there were other methods of regarding the phenomena of "easy glide" as well as that put forward by Dr. Thompson. With regard to Mr. O'Neill's work, it would be necessary to exercise considerable care in applying the data. It had to be borne in mind that he was not dealing with a pure material, but with one which contained 2 per cent. of silicon, which must affect the movement along the gliding planes.

Miss Elam expressed her disagreement with the opinions put forward in the paper by Dr. Thompson, as the evidence, such as it was, was in absolute disagreement with the theory. Any sort of movement such as was described would lead to the breaking up of the structure or to the phenomenon of twinning. No theory should be advanced which did not take into account the known facts, and that had not been done in the present case.

Dr. W. H. Hatfield said he had read the account of the work on the plastic deformation of α and γ iron with great interest, but thought that until physicists had a more correct knowledge of the nature of the atom it was too early to build up an elaborate theory of the kind outlined in the paper. On the subject dealt with by Mr. O'Neill he associated himself with the criticism made by Professor Edwards, believing that the silicon content must have definite and far-reaching effects.

Dr. Hanson said the theory of the plastic deformation of α and γ iron was built up on the assumption that slip in the crystals could only take place in certain directions. That was not the case. With regard to the contention that slip always took place on octahedral planes, his experiments on crystals of aluminium, carried out in association with Mr. Gough, negatived that suggestion. Nor could he accept the explanation of the maximum yield in α iron, which, it was said, depended on certain types of slip in body centred cubic crystals. It would appear that what happened in the case of nickel, which had a bigger yield point than iron, did not agree with the theory of Dr. Thompson and Mr. Millington.

Mr. E. H. Saniter questioned the yield point of 7.6 tons per square inch given in Mr. O'Neill's paper for armco iron. That was an extremely low figure for that material.

Dr. Thompson, in a short reply, which will be amplified by correspondence, said that critics might have given the authors credit for not believing that the atom was exactly like a ball. With regard to the physical constitution of the atom, he had discussed that question with workers at Manchester, and it would appear that from the point of view of the physicist there was nothing in the constitution of the atom as it was at present understood which was at variance with the theory propounded in the paper. On the other hand, the number of points which the theory explained, and which had never been explained before, was strong confirmation of the soundness of the methods used. In answer to Dr. Rosenhain, he noted one of the most important deductions made met with his unqualified acceptance. He welcomed the suggestion of Colonel Belaiew that the theory should be tested by experiments, and could inform him that experimental work with chromium was now receiving consideration.

Mr. L. B. Pfeil then introduced a paper by Professor C. A. Edwards and himself on "The Production of Large Crystals by Annealing Strained Iron."

THE PRODUCTION OF LARGE CRYSTALS.

The present research was carried out to determine the conditions under which very large crystals are formed in iron by annealing after plastic deformation. From a consideration of the experimental work which is described in the present paper, the authors feel justified in concluding that :—(*a*) The conditions have been determined under which it is possible to grow large iron crystals, and (*b*) the orientations of the large crystals appear to bear a relation to the direction of straining and to the surface of the strip. Further, two facts have been established which the authors consider to be of fundamental importance, namely : —(1) The critical strain required to produce very large crystal growth on subsequent annealing varies with the initial grain size of the material used. This variation is in the direction of a greater strain being needed as the grain size increases. With very large crystals, sufficient strain to cause growth cannot be applied, owing to recrystallisation occurring at the crystal boundaries. (2) Surface crystals of the original finely crystalline aggregate behave differently from interior ones, requiring a greater tensile strain before they will disappear.

Miss Elam admitted that Dr. Carpenter and herself had not obtained such good results as those disclosed in the paper. It seemed difficult to understand why small crystals did not give the same kind of result as larger crystals.

Mr. O'Neill referred to the paper by Osmond and Fremont published in 1905, which bore upon the work described in the paper. They had investigated the mechanical properties of large single crystals of iron measuring 1½in. overall and ⅜in. in diameter. The question raised as to the need of decarburisation was very interesting, as Dr. Stead and Professor Sauveur had stated that it was impossible to get grain growth with electrolytic iron. A certain amount of carbon must be present. Elastic limit results were required, and these would doubtless follow in due course.

Mr. Thos. Turner, drawing an example from commercial work, said in the cycle trade manufacturers did not wish to have the handle bars roughened by large crystals, and it would be of interest if the authors would indicate the conditions under which large crystals were not produced.

Mr. E. H. Saniter, dealing with the same branch of the subject, emphasised the need of information being available of the methods by which the sizes of crystals could be reduced to a minimum.

Dr. Carpenter, speaking from knowledge of the experimental difficulties, expressed his admiration of the work which had been done. The ideal experimental conditions had not yet been determined, but the authors had shown that certain conditions must be fulfilled if success was to be attained. The paper was likely to become a classic in the history of work on single cystals and should yield important results.

Professor C. A. Edwards, in closing the discussion, expressed his interest in the work which was being done on aluminium and zinc crystals, to which Miss Elam had referred, and in which the conditions met with were somewhat different from those in the case of iron crystals. With reference to the carbon content, an iron with 0.9 per cent. of carbon was common in basic open-hearth furnace work. The reason for the behaviour of the carbon was that it was not in solid solution, whereas the phosphorus and manganese were in that condition. The variation in the results stated in the paper as compared with those of Osmond and Fremont might, he thought, be due to the difference in the manganese content. Tests were now being carried out with the object of determining the elastic limit and other mechanical properties. He appreciated the request by Mr. Turner for negative results, but it would require a long paper to deal with that aspect of the question, and indeed at one period of the work Mr. Pfeil and himself were so disheartened at the lack of success that they nearly decided to abandon the work. The next stage of the investigation from the practical point of view would be to obtain information as to the conditions which brought about the production of small crystals.

The session closed with the presentation of a contribution by Mr. A. Westgren and Mr. G. Phragmen, "X-ray Studies on the Crystal Structure of Steel—Part II.," which, in the absence of the authors, was taken as read and will be discussed by correspondence.

* These figures are taken from Sauveur's "Metallography and Heat Treatment of Iron and Steel" (1916). The results in the original paper contributed by Sauveur to the International Association for Testing Materials, Vol. II., Part II., and quoted by Chappell, read : "Yield point, 35,000 lb.; maximum stress, 57,000 lb.; critical stress, 50,000 lb." The latter figures are probably incorrect.

United States Patents of 1923.

THE report of the United States Commissioner for 1923 has recently become available, and contains much matter of interest to inventors generally and to those concerned with the industrial property position of the United States of America.

The outstanding feature to be noticed is that the Patent Office work, which was very materially in arrear, is being expedited, although it is still much behindhand. In 1921 and 1922 the number of applications filed in the United States Patent Office in respect of patents was about 9000 per month, whereas the office could only deal with about 7500. From the two years about 30,000 cases fell into arrear, and these, added to 42,000 cases needing attention, gave a volume of work equal to about that of one pre-war year. By the addition of extra staff, a gain of about 1000 cases per month was made on the arrears. At the present time there are about 67,000 patent cases on hand, with 900 design cases and 2100 trade-mark cases awaiting action. It is expected that it will be five years before the work is current. Until recently an applicant for a patent might wait fifteen months for the first action on his case, but at the present time the maximum period is estimated to be about nine months.

In the issue division of the Patent Office, in addition to the patents, the *Official Gazette* is published weekly. This book is more extensive than the British *Illustrated Official Journal*, and contains about 250 pages, with about 1100 cuts.

This department controls the issue of about 1000 original patents and trade-marks each month. In the United States printed copies of patents cost from 6 to 7 cents each, and are sold for 10 cents. There are about 50,000,000 copies in stock, and approximately 200,000 are sold per month. The cost to the public of printed specifications issued from the British Patent Office is at present 1s. each. The photo-copying in the United States Patent Office is considerably in arrears, but the service is being improved. In 1921 orders were in arrears by about 160 days, the present time being 30 days.

There was a deficit on the receipts compared with the expenditure of the Patent Office for 1923. The receipts amount to 2,969,908 dollars and the expenditure rose to 3,216,343 dollars, giving an adverse balance of 246,435 dollars. This sum, taken from the net surplus in the Treasury of 8,587,776 dollars, leaves a total net Treasury surplus of 8,341,341 dollars.

As regards the business for the year 1923 there were 76,652 applications for patents for inventions, 3550 applications for design protection, and 320 re-issue applications, making 80,522 applications altogether. Moreover, 131 cases were filed without fees.

It is interesting to note the distribution of patenting over various states. The following table shows the number of patents, including designs, issued to citizens of the United States in certain of these states, with the ratio of population per patent granted :—

State.	Patents.	Population per patent.
Alabama	106	14,146
California	2,340	1,465
Georgia	192	15,082
Idaho	92	477
Illinois	3,925	1,652
Massachusetts	2,065	1,866
New York	6,052	1,716
Pennsylvania	3,105	2,809
Washington	566	2,397

The number of patents granted to residents of certain foreign countries is as follows :—

Austria	59	Italy	80
Belgium	73	Japan	52
Canada	660	New South Wales	53
France	424	New Zealand	52
Germany	782	Norway	51
Great Britain	1220	Sweden	116
Switzerland	161		

The variation in patent applications and patent grants for a series of years can be followed from the appended table :—

Year.	Patents and designs applications.	Patents and reissues.
1837	—	435
1840	765	473
1913	70,367	35,788
1921	93,328	41,401
1922	88,930	40,297
1923	80,522	40,787

The total number of patents issued up to 1923 is 1,478,996 in the current series, plus 9957 in the old series —that is, prior to 1836. In the year 1923 itself, there were issued 38,634 patents for inventions, 1927 patents for designs, and 226 re-issued patents, together with 14,845 trade-marks. As a figure which may be useful for comparison, it may be noted that the number of applications for patents filed in the British Patent Office during 1923 was 32,637.

LECTURING to the Royal Society of Arts on April 25th, Dr. V. E. Pullin, Director of Radiology at Woolwich Arsenal, recalled that the world aeroplane flight had been delayed by a defective casting. Why, he asked, had it not been X-rayed ? X-rays could be used by workmen with ease and accuracy—they were not "something for the laboratory." Their value was incalculable. They could peer into 3½in. to 3¾in. of solid steel, and there was no reason why they should not penetrate a plate of 8in. or 9in. A set of slides of aeroplane parts shown by the lecturer revealed defects in workmanship or material that could only have been discovered by the use of X-rays.

Electricity Supply in Wartime.

At the monthly meeting of the Diesel Engine Users' Association, which was held on Friday last, the 9th inst., a paper of unusual interest was read by Mr. A. H. Dykes and Mr. W. T. Townend on "Electricity Supply in Wartime, as affected by the Improvements in Heavy Oil Engines." The paper in question forms a strong plea for a consideration of the extreme vulnerability of our large super-power stations to enemy air attack, a matter of increasing importance in view of the present-day tendency throughout the country to replace the smaller local stations by a few large capital stations serving large supply areas by means of high-tension feeder cables. The authors call attention to the conspicuous appearance of our large power stations, and their prominent positions on large rivers, which, in conjunction with coal storage dumps and railway lines leading to them, would undoubtedly help to form an easy target for effective air attack. From a consideration of the present position, the authors have been led to the conclusion that if such dangers are to be taken into account and protection against interruption of supply provided, the only practical way of overcoming the difficulty is to provide within a given area a certain number of underground generating stations, driven by heavy oil engines. The choice of suitable sites for such stations would not be limited by the necessity of providing for adequate supplies of condensing cooling water, as in the case of large turbine-driven stations, and the underground stations could, moreover, be placed in the centre of the supply load, thereby reducing the heavy cost of trunk mains and sub-stations. In a section devoted to oil fuel supplies, the opinion is expressed that no reliance should be placed on native liquid fuels, such as tar distillates, as other industries exist which make full use of the home supply of creosote oils, for the treatment of timber and the manufacture of disinfectants. It is suggested that the oil engine stations should rely on imported petroleum fuel and that even in wartime adequate supplies could be maintained by a service of submarine oil tankers. The authors placed before the meeting full plans with capital and running costs of an oil engine-driven underground station, with a plant capacity of 17,500 kilowatts, and a maximum load capacity of 14,000 kilowatts, with one generating set in reserve. An extent of 2 acres is allowed for the building of the station, but the actual area would not be more than half an acre, and all other land, including perhaps the surface area immediately above the station might be available for building purposes after the station was once constructed.

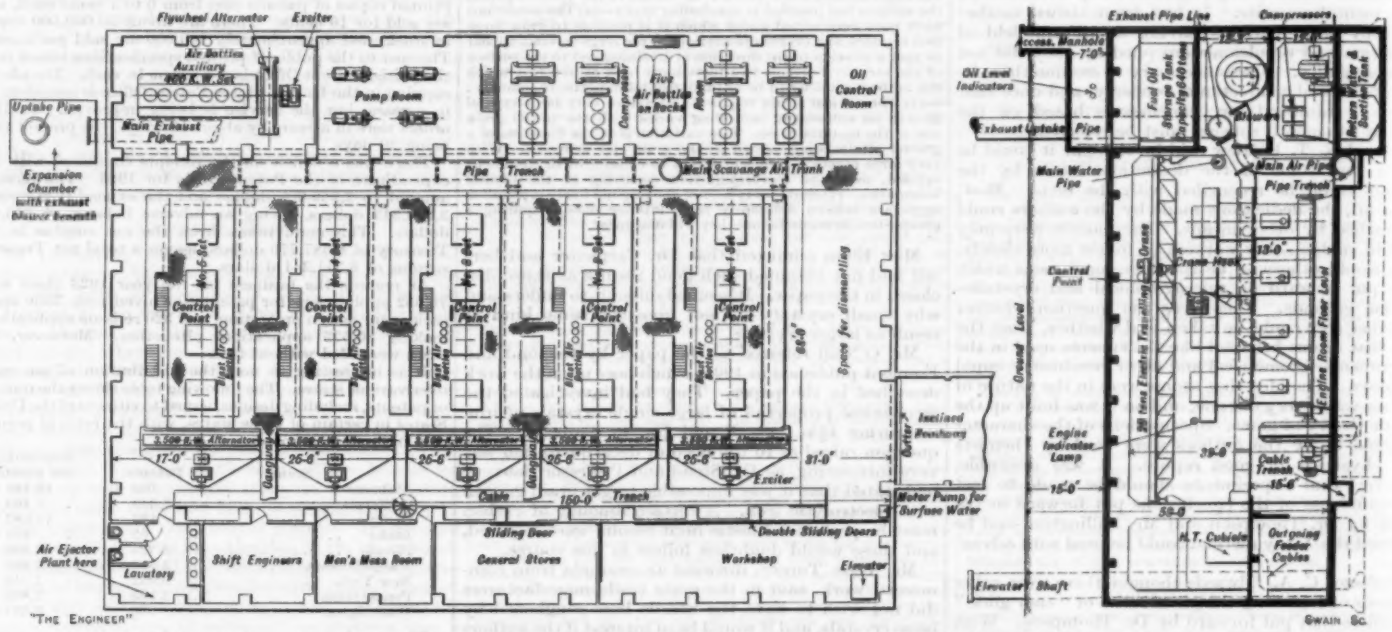
In the accompanying drawing we reproduce a plan and section of the proposed station. The building itself would be constructed on the principle of a box girder, the whole of the work being carried out in reinforced concrete. The side walls, it may be noted, consist of vertical members or piers which are spaced about 12ft. apart, the side thrust being taken on the horizontal members at the top and bottom, while additional strength is given by the two outer walls, which are braced to the inner walls by means of the horizontal and vertical members of the floors and the division walls. Some 15ft. of solid earth are allowed as a cover above the reinforced concrete roof, it being suggested that this thickness of earth would be sufficient to protect the structure against the heaviest bomb now made. The main engine-room is 15ft. long by 60ft. wide, with a height of 43ft., giving 31ft. to the underside of the hook of the travelling crane. On one side of the building are placed the main switchboard and offices, while on the opposite side are the oil storage tanks, the pump-room and the oil control room. Access to the station is given by an inclined roadway.

The station would be equipped with five sets of 3500-kilowatt oil engine-driven alternators, one set of which would form the reserve unit. Each alternator is shown coupled directly to an eight-cylinder heavy oil engine of the opposed-piston type, which would be designed to generate 5000 brake horse-power when running at a speed of 150 revolutions per minute. This speed gives a comparatively low piston speed of 750ft. per minute, which, the authors state, would have a very beneficial effect on the wear of the liners and the pistons, and would tend to reduce the running costs. All the engines would be controlled from a common upper platform connecting with the switchboard gallery. A separate compressor-room would be provided with four three-stage air compressors, each driven by a separate motor. As shown, one starting receiver for each engine would be placed in the compressor-room and three air injection receivers alongside each engine. On an upper level there would be three electrically driven turbo-blowers, each with a capacity of 48,000 cubic feet per minute, which would supply the scavenge air, and be so arranged that they would draw their air supply from the main engine-room, and, together with the exhaust discharge blower, assist in maintaining a fresh supply of cool air throughout the station. All auxiliary motors would be normally supplied from a works transformer, running in parallel with a 450-kilowatt oil engine-driven alternator. This auxiliary set would also furnish light in the event of a failure at the main switchboard, and would provide power for starting up again after the main engines for any reason had been shut down. An important factor in the design of such a station as we are describing is the provision for engine cooling water. The authors estimate that about 200,000 gallons of water per hour would be necessary, and they suggest that in most situations this water might easily be obtained from a neighbouring stream or an ornamental lake or pond near to the site. Assuming an outlet temperature of 120 deg. Fah. for the cooling water leaving the engines, a pond of one-tenth of an acre, or say, 500 square yards in area would suffice. About 10,000 gallons per hour would be necessary to make up for loss in evaporation. Water-softening plant arranged near the pond intake might be used if necessary. With the scheme described, the water would flow through the engine cooling water supply circuit by gravity and would be returned to the pond by electrically driven circulating pumps. Arrangements would be provided for the storage, filtering and centrifugal cleaning treatment of fuel and lubricating oil, and no difficulty might be expected in using fuel oil of ordinary boiler firing quality. Provision has been made in the scheme for the storage of 640 tons of fuel oil, equivalent to one month's supply, when working at a load of 13,500 kilowatts at a 25 per cent. load factor. The oil would be contained in two reinforced steel tanks 18ft. 6in. by 10ft. by 68ft. long. Ready-use tanks, with a capacity of 1500 gallons, or an eight-hour full-load supply, would be fixed in the engine-room, and served from the main tanks by an oil fuel pipe line.

Brief references may be made to the exhaust system. Electrical pyrometers would be fitted to each cylinder, so that the temperatures could be under the constant observation of the shift engineer. The main exhaust pipe from each engine would deliver its exhaust through an angle connection to the main exhaust trunk, which, it will be seen from the drawing, runs throughout the length of the station, and expanding from a diameter of 3ft. to 6ft. by consecutive steps, leads to an expansion chamber. An air ejector placed on the upcast pipe from the chamber draws away the exhaust gases and discharges them to atmosphere.

In the estimates of capital cost and running charges, which the authors submitted, it was shown that such an underground station would compare favourably with the costs of a modern provincial 20,000-kilowatt steam station with two 10,000-kilowatt turbine units.

The paper gave rise to an interesting discussion, to which members and visitors contributed. Opinions varied as to the effectiveness of the 15ft. of earth above the reinforced concrete roof, and an airman present stated that although it might not be possible to penetrate the station by bombing, it was quite certain that bombs dropped from a height would cause considerable damage to the ground around he station, and might quite well interfere with its working.



PLAN AND SECTION OF SUGGESTED UNDERGROUND ELECTRIC GENERATING STATION

THE scheme for ocean wharves, piers and the necessary railways to make Falmouth into a Transatlantic port has again died a natural death. The promoters could not find the necessary capital, and on the 7th inst. a Bill for the abandonment of the scheme and for the release of the deposit was passed by the Unopposed Bills Committee of the House of Commons.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

MACHINE TOOLS AT WEMBLEY.

SIR,—A correspondent who signs himself "C. M. E." in your current issue calls attention to the fact that the members of the Machine Tool Trades' Association are not exhibiting individually at Wembley. This is, of course, perfectly true, and the reason for the absence of the members of the Association is that ever since the Association was formed in 1910 it has held its own Exhibition from time to time at Olympia, where its next Exhibition will be held from September 5th to 27th next, and where it is hoped to see a large number of engineers from overseas who are interested in machine tools. Most of the machine tools exhibited at Olympia will be shown in operation, and visitors will have an excellent opportunity of seeing a very complete display illustrating the position and progress of the British machine tool industry.

In the meantime, it is important to point out to visitors to Wembley, through the courtesy of your columns, that this Association has a stand at the Exhibition, No. 284, S.E. Block, Bay 28, where the catalogues of all the members of the Association are filed for reference, and where full information as to the products of the various members of the Association is available.

I am informed by the manager of our stand that the information which is available has been placed at the disposal of every visitor to our stand, where, in addition to the members' catalogues referred to above, there is also available the collective catalogue just published by the Association which contains information with regard to the products of the majority of our members, and this catalogue contains in it a detailed chart showing the products of the members.

A more complete chart, relating to the products of the whole of the members of the Association, is in the printer's hands, but, unfortunately, owing to the printing taking a good deal longer than was expected, this chart, at the moment of writing, is not yet available at Wembley, but I gather from the manager of our stand that a copy of this chart was specifically promised to the visitor who appears to be the writer of the letter which is signed "C. M. E.," and in any event, I should like to assure "C. M. E." that I shall have the greatest pleasure in sending him a copy of this chart if he will be kind enough to communicate with me. The list of members which was offered him he decided not to take because the chart would shortly be available.

The stagnation in the British machine tool trade, to which "C. M. E." refers, was an absolutely unavoidable sequel to the war. The enormous number of machine tools turned out by the members of this Association during the war was bound to result in the existence of a large surplus of machines at its termination. "C. M. E.," however, will be pleased to hear that this surplus has been almost entirely absorbed, and that the trade conditions are rapidly improving. In fact, some of our members are extremely busy.

I am unable to follow the reasoning of "C. M. E." in his suggestion that the foreign visitor to Wembley will return home thinking that the only machine tools which he can purchase are those made in America and other countries. As both American machine tool manufacturers and also the members of this Association are absent from Wembley, it is difficult to understand why this fact should reflect favourably on the former and unfavourably on the latter.

A reference to your advertising columns would give "C. M. E." much of the information he requires, and would, I am sure, show him very conclusively that the members of this Association are very much alive indeed.

HERBERT G. WILLIAMS,
Secretary, Machine Tool Trades' Association.
London, S.W. 1, May 13th.

As from June 3rd there is to be an acceleration of 3½ hours in the journey between Hook of Holland and Berlin. A train-de-luxe, with first-class accommodation only, will run three times weekly and seats therein will have to be booked in advance.

Railway Matters.

CABLE advices state that the New Zealand Government intends to have an exhaustive inquiry into the whole of its railway system.

THE long established practice of supplying a red tie to be used as a danger signal in case of emergency to the staff of the London and South-Western Railway, is to be continued and spread to the whole of the Southern system.

THE coroner's inquest into the cause of the death of the five passengers killed in the collision of April 26th at Euston was resumed on Friday last. After hearing considerable evidence, the inquiry was again adjourned. It will be resumed on June 6th, presumably to hear the evidence of the motorman of the electric train.

THE Great Western Railway has lower rates for milk from its Wiltshire stations to London than has the Southern Railway. The Minister of Transport has pointed this out to the latter company but, Mr. Gosling stated on the 6th inst., it does not see its way to follow the Great Western example. It is open to the aggrieved parties to bring the question before the Railway Rates Tribunal.

ASKED whether, in view of the necessity of the interests of railway passengers being adequately represented on the Railway Rates Tribunal he would appoint one from the general panel to serve on that body, the Minister of Transport has replied that the rules made by the Tribunal provide for a procedure under which parties, desirous of requesting that additional members may be added, may apply to the Tribunal.

THE Irish Railway Wages Board began, on the 28th ult., an inquiry, under the presidency of Mr. Justice Wylie, as to an amendment of the existing national agreements. On Thursday, the 8th, it was announced that the Board had found it impracticable at this juncture to agree upon any changes in existing rates of pay and conditions of service, especially having regard to impending changes in the railway systems.

PART of the economy in passenger train mileage now being waged is the withdrawal of one of the night Scottish expresses in each direction by the Midland route and the 1.25 p.m. from St. Pancras to Manchester, Victoria, and and 1.15 p.m. Manchester, Victoria, to St. Pancras. Little public inconvenience will be caused by these withdrawals. There is a train to Scotland from Euston at the same hour, and trains from St. Pancras to Manchester at 12.25 and 2.25.

ACCIDENTS to passengers falling from trains were the subject of an inquiry in Parliament the other day. It was stated, in reply, that there were 24 fatal cases in 1922 and 25 in 1923. A small proportion of these accidents was due to persons opening the wrong door, but it was not possible to give reliable figures as to the exact number. It was the general practice to provide a different type of door and of door-fastening for outside and corridor doors respectively.

SPEAKING at the annual dinner on the 7th inst. of the Railway Benevolent Institution, the Lord Advocate, Mr. H. P. Macmillan, referred to the group system on the railways. It was no doubt a great experience, he said, for it was a partial nationalisation of the railways in that there was a participation of the traders in the well-being of the railways which they had never had before, and it was his belief that what had been brought about would be productive of both economy and efficiency.

WHEN Mr. Gosling, answering a recent question, said that he had had no complaints on the insufficiency of workmen's trains, he was asked the supplementary question: Was he aware that on the London and North-Eastern Railway he would regularly see 26 to 28 persons being carried in a compartment that should only hold 12, while at the same time the first-class carriages frequently had nobody in them at all? The Minister of Transport replied that if specific cases were given him he would go into them.

FOLLOWING the practice initiated by Sir James Inglis when he made Mr. H. Deans, of the engineer's department, the assistant storekeeper to the Great Western Railway, the directors of that company have now made Mr. A. G. Cookson, steelwork assistant in the engineer's department, assistant storekeeper. This excellent policy of appointing a practical man to the important position of storekeeper was followed by the London and South-Western Railway in the person of Colonel Francis, who now holds that office on the Southern Railway.

THE director of the Jamaica Government Railways has been having a dispute with the Legislative Council, and Sir Leslie Probyn, the Governor, has suggested to the Secretary of State for the Colonies that a Royal Commissioner or a commissioner be appointed to inquire into the administration of the railways. Mr. J. H. Thomas, answering a question in the Commons on the 5th inst., said that all the evidence tended to show that the director was a most energetic and capable man, and nothing will be done to prejudice his position pending a full inquiry.

IT is reported that tests of new motor generators for electric locomotives to be placed in service on the Detroit, Toledo and Ironton Railway, have proved successful. The experiment, it is expected, will result in a saving in long-distance transmission of electricity for railway operation and in a saving in copper owing to the use of small diameter wire. The Detroit, Toledo and Ironton *News* says that these tests demonstrated the practicability of using high-tension alternating trolley current of 23,000 volts to operate locomotives equipped with 600-volt direct-current driving motors—a combination never before attempted. The new Detroit, Toledo and Ironton locomotives will be the first units of their type to be equipped with self-contained apparatus for rectifying alternating-current to direct-current. Thus, the advantages of high-tension alternating-current in trolley lines may be obtained in conjunction with the superior qualities of power production and facility of control inherent in the low voltage direct-current motor.

Notes and Memoranda.

AT the annual meeting of Bridgnorth Rural District Council, correspondence was read from the Aveley, Quatt and Chilmarsh Parish Councils, urging the Rural District Council to support the proposal to erect a bridge over the river Severn. The Clerk was directed to write the Salop County Council stating that the Rural Council was strongly in favour of the erection of a bridge over the Severn between Bridgnorth and the Worcestershire boundary.

LARGE deposits of copper ore, pyrites and arsenic ore, the last-named containing 30 per cent. of arsenic, have, it is reported from Stockholm, been found in the province of Vaesterbotten, not far from the rich copper and sulphur deposits discovered at Bjurfors. M. Galvelin, the Chief Royal Geologist, says that the deposits may prove very valuable, especially as arsenic ore has not previously been found in Sweden. An investigation of the new deposits is being made on the initiative of the holding company, Centralgruppens Emissionsaktiebolag.

THE National Federation of Iron and Steel Manufacturers report that the production of pig iron in April amounted to 618,400 tons, compared with 668,600 tons in March and 652,200 tons in April, 1923. The number of furnaces in blast remains the same as at the end of March, viz., 194, compared with 202 at the end of February. The production includes 188,400 tons of hematite, 221,400 tons of basic, 145,800 tons of foundry, and 33,700 tons of forge pig iron. The output of steel ingots and castings in April amounted to 711,500 tons, a decrease of 105,400 tons compared with March, and a decrease compared with April, 1923, when the output amounted to 749,400 tons.

RECLAIMED reinforced concrete sheet piles were used by the Gulf, Colorado and Santa Fé Railway for the foundations of the canopies over the new platforms at its station at Galveston, Tex. The sheet piling had been removed from the Galveston causeway more than a year ago, when a portion of the fill was replaced by extending the viaduct. Although the piles had been exposed to sea water since 1910, they were found, says the *Engineering News-Record*, to be in first-class condition. They were made of 1 : 2 : 4 concrete and were cured two months before being driven. Some of the reinforcing was exposed during the removal of the piling, and it was found to be unaffected by the action of sea water. The piles were so sound that none of them were broken in the re-driving.

AT a sitting of the Royal Commission on Mining Subsidence, Mr. Alfred S. Blackman gave evidence on behalf of the Incorporated Municipal Electrical Association, and said that the chief desire of his Association was to secure support for its cables and stations, and compensation for any damage done by subsidence. In present circumstances, faults and breakdowns in their consequent on coal-mining operations were serious to any undertaking, for, in addition to the loss of revenue occasioned by a breakdown, it created lack of confidence in the continuity of supply, and consequently its development was seriously hampered. There was also, in the case of a large industry dependent on electrical supply, loss of time and wages to workpeople through such breakdowns.

IN a paper recently read at the Institution of Petroleum Technologists, Mr. R. K. Richardson stated that the richness and sustained production of the Maidan-i-Nafton oilfield made it one of the most important of the world's petroleum resources. The field is situated approximately 140 miles N.N.E. of the port of Abadan, on the Shat-El-Arab, to which place oil is transported by pipe line. "The boundaries of the productive area," said Mr. Richardson, "are being continually widened by prospect wells, but the extent of its untapped reserves is still unknown." Production figures which have already been published representing the volume of oil extracted from a relatively small number of wells show an extraordinary increase in the annual production. Thus, in 1912–13, 21,896,714 gallons of crude oil were produced, equal to 82,629 tons, while in 1922–23 the quantity was 788,209,802 gallons, or 2,941,081 tons.

SOMETHING unique in the way of electric steam boilers was recently installed in the Berlin N.H. (United States of America) plant of the Brown Company of pulp, paper and chemical manufacturers. Operating at a pressure of 22,000 volts, three-phase, 60 cycles, an electric boiler of 18,000 kilowatts generates 50,000 lb. of steam per hour at 135 lb. gauge pressure. The boiler was installed mainly to supply steam for twenty-three hours on Sundays and other holidays, when the mill is shut down, but when steam is still required for the sulphite digesters and other chemical plant. The unusually high voltage was proposed in order to avoid the expense of step-down transformers, and several difficulties at first anticipated did not materialise. The boiler consists of three vertical tanks, each 84in. diameter, and 82in. high between heads. It occupies a floor space of 25ft. 6in. long by 8ft. 2in. wide, and is 15ft. 6in. high from floor to cable terminals. With continuous running the electrodes are estimated to last a full year.

THE Department of Scientific and Industrial Research announces the publication of a third edition of Fuel Research Board Special Report No. 1, on "Pulverised Coal Systems in America." Prepared by Mr. L. C. Harvey, the first edition of this report was published in 1919, and a revised edition, embodying much further information which had been accumulated, especially from large users of pulverised coal in America, was issued in 1921. It has now become necessary to issue a further reprint. Opportunity has been taken to make a few additions and alterations, the most important having reference to results obtained with pulverised fuel in malleable iron melting furnaces and to some recent large power-house boiler installations. The present edition of the report is arranged under the following headings:—Conditions with Pulverised Fuel; Notes on Range of Fuels Suitable; Cost of Installations and Cost of Powdered Coal; Standard Mill House Practice and Tabulated Answers given on Questionnaire Sheets sent to American Users of Pulverised Coal; Transportation of Coal Dust to Burners; Notes on Pulverised Coal Storage and Spontaneous Combustion; Feeders, Mixers, and Burners; Applications; Opinions of Users; Working Results, &c.; Conclusions. Five appendices are also included, and the work contains nine text figures and twenty-one plates.

Miscellanea.

IN view of the approaching transition to the metric system in the Soviet Republics, there is an enormous demand at present for metric scales and weights.

THE profit-sharing scheme in operation at the works of Horace Green and Co., Limited, of Cononley, Keighley, is simply based on the wages paid ranking as capital. Since the introduction of the scheme, an average dividend of 8 per cent. has been paid, and in the present year it amounts to 7½ per cent. This result is noteworthy considering the difficult trading conditions contended with during the year.

TENDERS are being called for the construction of the tunnel to connect Alouette and Stave lakes, which the British Columbia Electric Company has projected in order to increase its power supply. The tunnel will be 3400ft. in length and 15ft. in diameter. The power-house at the Stave Lake end of the tunnel will develop 11,500 horsepower, and it is expected that the plant will be completed and in operation by the end of 1925.

TWO business quarters of Winnipeg will be served with heat this year from the municipal central steam heating plant, the installation of which was authorised by the city ratepayers at the last civic election. Tenders for the construction of the 300,000-dollar distribution plant will be invited shortly. A loop distribution system will be substituted for the proposed tunnel, and a single 14in. main will circumscribe the two districts to be served.

WE hear that intimation has been received by the financial general secretary to the Glassworkers' Union that in view of the announcement that the Government does not intend to prolong the provisions of the Safeguarding of Industries Act, no good purpose would be served by sending a deputation to the Board of Trade to lay before that Department the serious position in which the glassworkers will be placed by the discontinuance of the McKenna duties.

MUCH excitement was caused at the Surrey Commercial Docks, London, a few days ago by the failure of a dam between the Canada Dock and part of the new extension works. Very high water in the Canada Dock caused extreme pressure on the dam, and the water found its way through underground. The sight of the rising flood caused considerable apprehension to men who were working in the extension, but, as a certain quantity of water has always percolated through, pumps were handy, and with the aid of these and of concrete slabs, which are used in the new workings, the trouble was soon got under control.

A MEETING of the executive of the Scottish Colliery Firemen and Shot-Firers' Association was recently held in Glasgow. Resolutions were drafted for the summer conference of the British Firemen's Federation, to be held in Edinburgh on June 26th and 27th, and it was agreed that the resolutions previously tendered be again forwarded to the Trades Union Congress to be held at Hull in September. Reports from the various districts in Scotland were given and considered favourable, but regret was expressed at the nature and number of accidents in the Scottish mines. The secretary, in making his report, stated that it was beyond contradiction that a number of accidents which had occurred could have been prevented.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in April amounted to 618,400 tons, compared with 668,600 tons in March and 652,200 tons in April, 1923. The number of furnaces in blast remained the same as at the end of March, viz., 194, compared with 202 at the end of February. The production includes 188,400 tons of hematite, 221,400 tons of basic, 145,800 tons of foundry, and 33,700 tons of forge pig iron. The output of steel ingots and castings in April amounted to 711,500 tons, a decrease of 105,400 tons compared with March and a decrease compared with April, 1923, when the output amounted to 749,400 tons.

THE accumulation of orders during the six months' labour conflict in the Swedish iron trade last year, says the *Swedish Economic Review*, enabled the ironworks to produce on a comparatively large scale, and during the last five months of the year and during the first months of 1924 production was maintained at the higher level thus induced. The following number of furnaces were working on February 29th, 1924 (the number of furnaces available is given in parenthesis):—61 blast-furnaces (128); 75 Lancashire open hearths (194); 9 Bessemer converters (18); 44 Martin furnaces (82); 12 electric furnaces and crucible furnaces (25). The conditions of the market are, however, such that no very favourable continuation of the curve of production is to be expected.

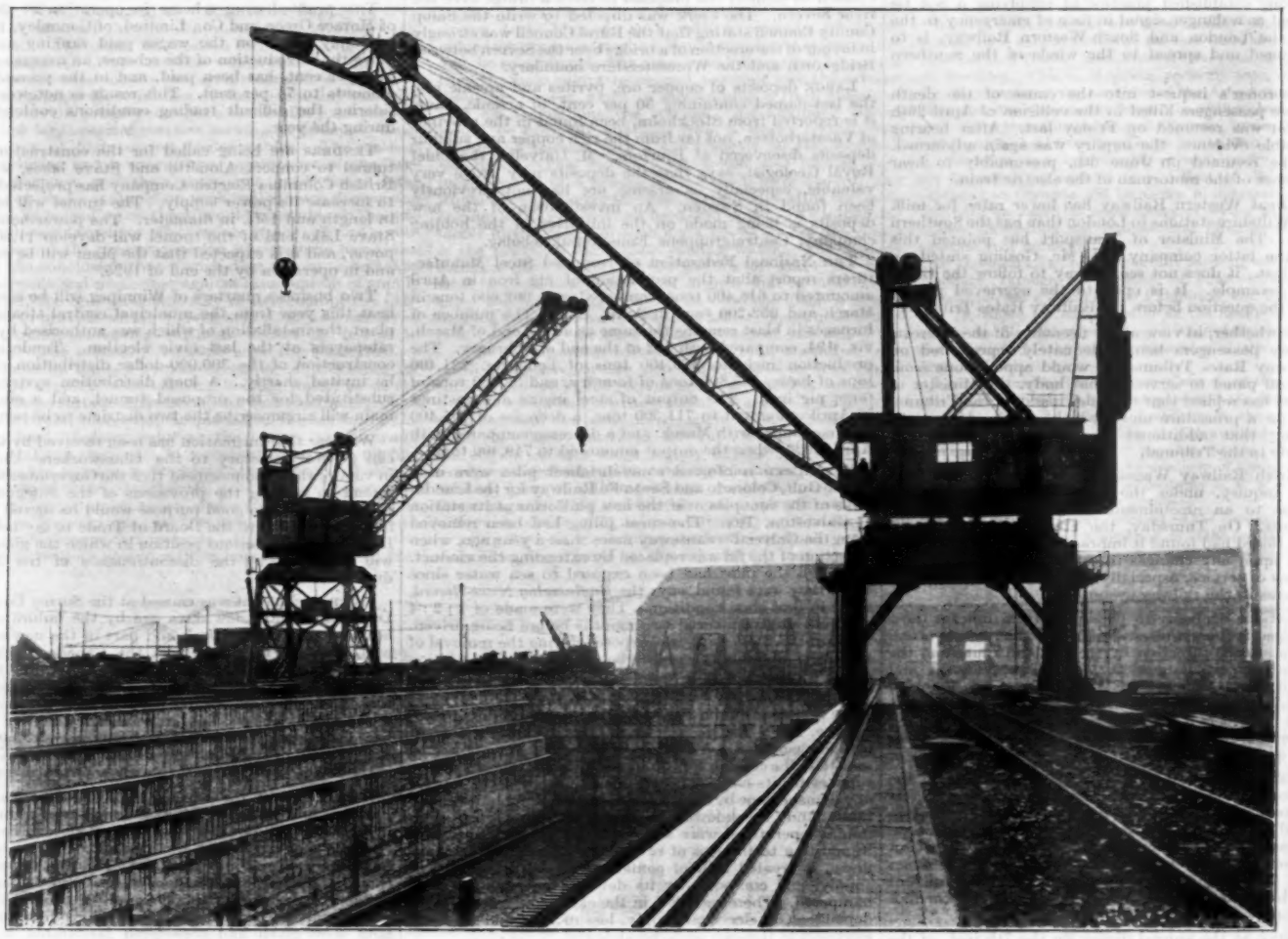
THE report of the United States Coast and Geodetic Survey for the year ending June 30th, 1923, contains the record of a great deal of valuable work in American waters. One of the many projects to which particular attention was paid was the charting of the Alaskan coast line and water routes. In view of the greatly increased volume of tonnage frequenting Alaskan harbours in recent years, this work was long overdue. The provision of suitable survey vessels has permitted it to proceed rapidly. The coastal features have now been surveyed in most parts of south-eastern Alaska, much of Prince William Sound, Cook Inlet and Kodiak Island, Kuskokwim Bay, and Norton Sound. Detailed surveys of several important harbours, notably Kachemak Bay, have been completed.

REGARDING a complaint of dangerous speed of the great liner Berengaria through Cowes Roads recently, the Cowes District Council has received a reply from the Cunard Line stating the master reported that when approaching Ryde and Cowes the speed of the vessel was reduced, and it was only increased when in deep water. At the actual time of passing Cowes the ship was proceeding at as slow a speed as was possible; any unusual swell in that instance might have been caused by the ship swinging rapidly round Brambly when entering the deep channel. The officers and pilots had instructions to give careful consideration in the navigation of steamers in the neighbourhood of Cowes and Ryde, and it was regretted if precautions taken on the occasion were not altogether effectual.

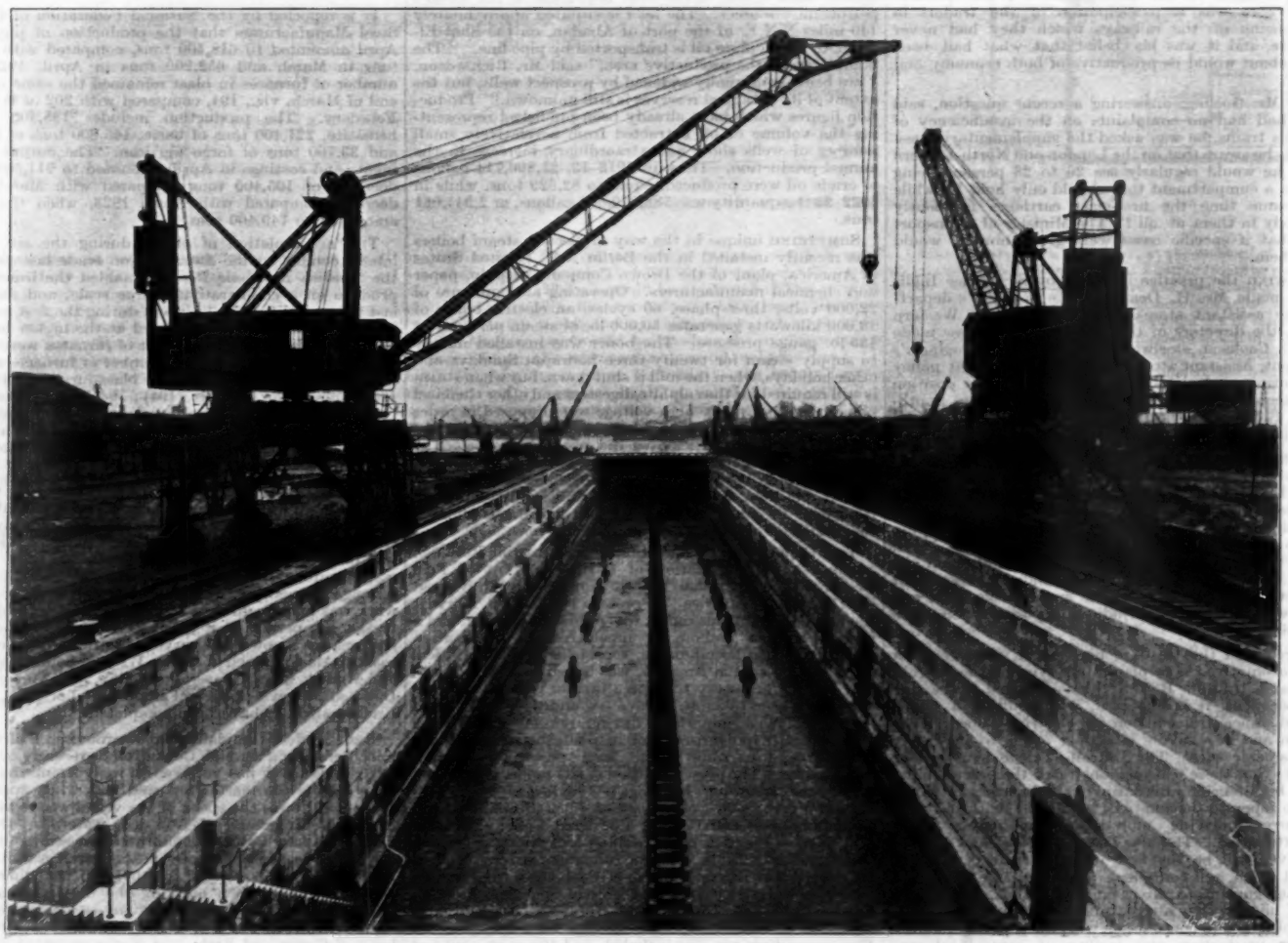
NEW DRY DOCK AT SWANSEA

MR. N. G. GEDYE, M. INST. C.E., WESTMINSTER, ENGINEER

(*For description see page 544*)



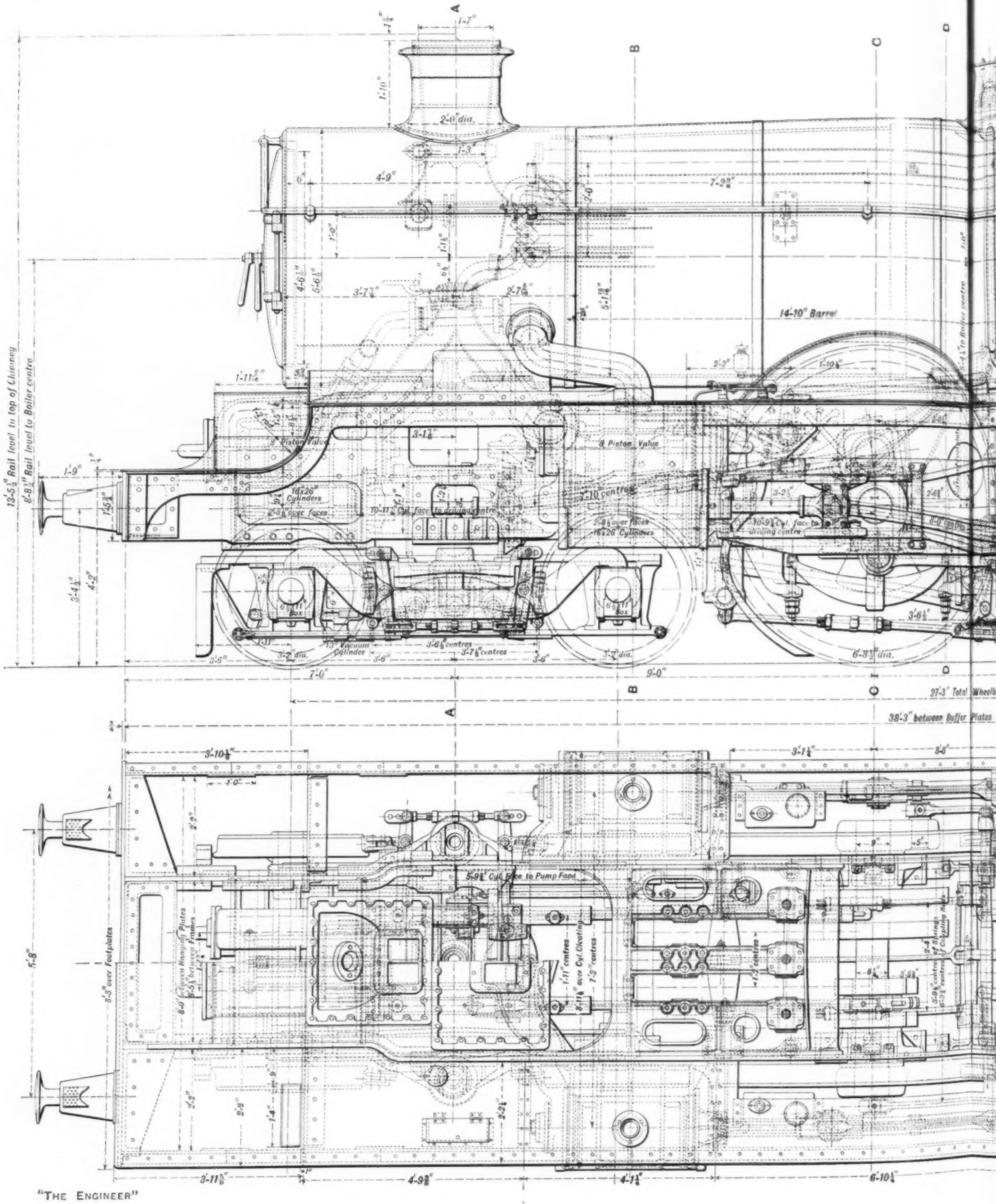
VIEW OF INNER END OF DOCK



VIEW ALONG DOCK LOOKING TOWARDS THE ENTRANCE GATES

EMPIRE EXHIBITION—GREAT WESTERN L

MR. C. B. COLLETT, M. IN



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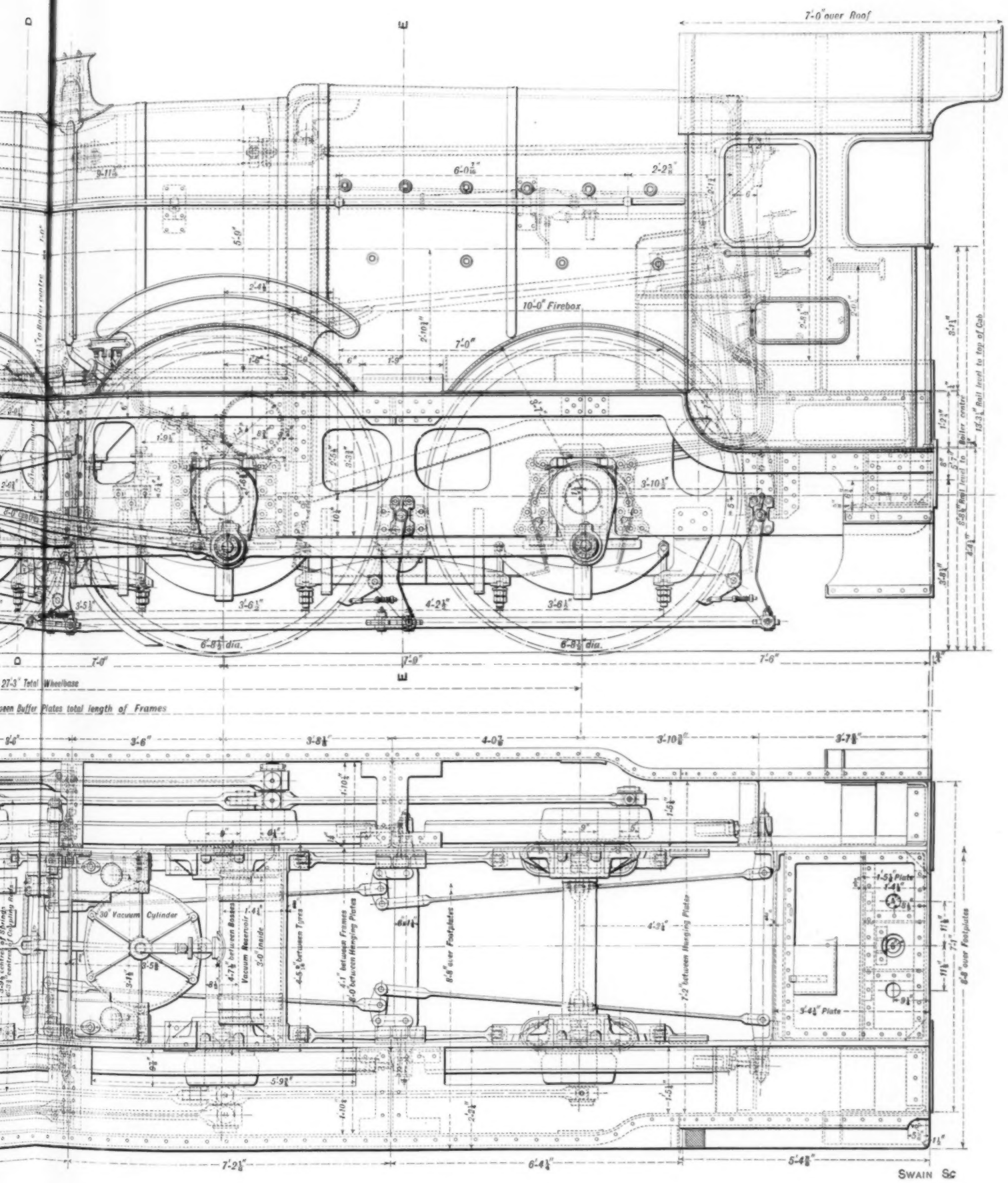
TERN LOCOMOTIVE "CAERPHILLY CASTLE"

T, M. INST. C.E., SWINDON, ENGINEER



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THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
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Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

. *With this week's number is issued as a Supplement a Two-page Plate of the Great Western Locomotive "Caerphilly Castle" at the Empire Exhibition. Every number, as issued by the Publisher, contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

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. *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

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TWO-PAGE SUPPLEMENT—EMPIRE EXHIBITION—GREAT WESTERN LOCOMOTIVE "CAERPHILLY CASTLE."

DEATH.

On the 9th May, at a nursing home, PAUL T. J. ESTLER, A.M. Inst. C.E., of "Grasmere," Hainault-road, Chigwell, Essex, in his 53rd year.

THE ENGINEER.

MAY 16, 1924.

Mass Production and Motor Cars.

IT has ever been our practice to refrain from the discussion of subjects that have become the tennis-balls of politicians. We have followed this practice because, in the first place, our pages are read by men of very diverse political views, and we could not expect, as the daily Press may justly do, to represent truly the opinions of the mass of our readers. In the second place, there is something repugnant to the normal scientific mind in political methods, which are more often remarkable for astuteness—both of debate and management—than for calm and logical reasoning. These reasons have appeared sufficiently weighty to make us abstain from the discussion of subjects which, had they never entered the political cockpit, would have been proper matter for our consideration. Tariff reform is a striking example. Had it remained—as, would to Heaven, it had remained—a party-free economical question, we should have felt it our duty, as it would have been our pleasure, to open our pages to a free and unheated discussion of it. That was not to be; it became a party, almost a personal, matter from the first, and opinions were controlled rather by the parliamentary whips than by reason. Even in the limited form of it which is presented by the McKenna duties on imported motor cars, it has not escaped from the political atmosphere, and we hesitate almost to touch upon certain aspects of the admirable and temperate speech which Mr. Baldwin made in the House of Commons on Tuesday last, lest we should be involuntarily led to infringe our own rules. But Mr. Baldwin is nearer to us, through his connection with a great engineering industry, than most politicians, and his speech bore on so much of a technical, rather than political matter, that we trust we may have the tolerance and sympathy of our readers if we say a few words about it.

It is, we believe, beyond contention that the motor car industry has enjoyed prosperity under the McKenna duties, whilst other industries which are not protected have languished. The motor lorry trade is an example to the point. Foreign lorries are not taxed as foreign cars are, and the competition from abroad has been so great that British manufacturers have had the greatest difficulty in securing sufficient orders to keep their works employed. It is the conviction of the motor manufacturers themselves—who certainly must be admitted as reliable judges—that the prosperity of the motor trade is the direct outcome of the duty. We are not concerned with other aspects of the question, or with incidental effects. We are content with the mere, admitted fact that the duty has benefited the motor car industry, and in benefiting the industry it has, of course, decreased unemployment. Now, there are very few industries indeed that lend themselves so well to mass production as the motor car industry, and although it is well-nigh fruitless to expect that England with its limited internal demand can ever emulate the great outputs of some American firms, yet in a relatively small way we were adopting mass production methods, and consequently reducing prices to a competitive level. But mass production is an exceedingly costly thing to establish. Money must veritably flow like water in the preparatory stages when special tools, special gauges, special rigs and jigs, special plant of all kind must be purchased. Some people write and speak as if mass production can be started out of hand and out of revenue. It cannot be. An enormous amount of money has to be invested before a beginning can be made, and, in consequence, the overhead charges are high. To reduce their incidence per piece, the output must be maintained constantly at the highest point, the works must operate continuously at full capacity. Any drop is immediately reflected in the net increase in the cost per car, and as the margin of profits is small, a gain is rapidly converted into a loss. Mr. Baldwin spoke with inner knowledge of such work, and his assertion that "to secure mass production for export you must have either, from natural circumstances or from a duty or from anything else, that security of markets which would enable you to produce up to the point when you can run a big place fully and reduce your overhead charges to a minimum. When you have reached that point, you can extend to any amount you like—that is what has happened in the Ford works." It is well known that we have not got that "security of market" for motor cars which Mr. Baldwin rightly regards as essential to mass production. We depend in large measure upon foreign markets, and our hold upon them is precarious; if the home market is also in a precarious condition, the chance of building up motor car factories comparable with those of America are remote indeed. Mr. Baldwin pointed out another view of mass production which has an important bearing on our prosperity. The American production of cars runs into millions, whilst ours is only in tens of thousands. But when one is working in millions a very small error in the estimation of demand may leave a huge number of cars unsold, a number, as Mr. Baldwin said, "that would swamp any market open to them." The price at which they may be sold is of relatively small consequence, and they may therefore be lightly dumped on any country that will receive them. Thus, it comes about that the already precarious condition of our market is made doubly precarious, and the difficulty of finding investors who are prepared to support mass production is augmented. Whether mass production is a good thing or a bad thing is beside the point. That it does lead to the development of vast factories and that it does provide a great amount of employment cannot be denied. As long as the world wants cheap motor cars, mass production must continue, and to build it up is a justifiable ambition of economists and industrialists who are concerned in the reduction of unemployment and the increase of the country's trade.

Looked at dispassionately and without political bias of any kind, it seems to us that the effect of the McKenna duty is to assist the motor car industry without damaging any other trade. It seems that with its help our motor manufacturers were reaching a point of stability from which further developments of an important order might be made. We look at that fact simply as a fact, and without any consideration of the tariff principles involved or of the history of the duty. We do not much care whether or not the duty favours one selected industry; we are not much moved by the thought that other industries might claim a similar privilege. There is no evidence that it causes injustice to anyone, whilst there is adequate evidence that it does good to a trade, encourages employment, and offers the means of

developing a highly competitive industry. For all these reasons we regret that it is so soon to pass away.

Power Transmission.

ONE of the most vital problems connected with the supply of electricity is the efficient and cheap transmission of power over long distances. When the use of overhead lines is undesirable or impracticable the employment of underground cables must be resorted to, and in this connection difficulties arise. Undoubtedly there are large areas in this country over which overhead conductors might be run, but, on the other hand, there are parts, such as those in the vicinity of towns, where transmission lines would be undesirable. Some contend that if underground cables could be worked at pressures similar to those which are applied to overhead lines it might be possible to obtain wayleaves over great distances, along existing trunk lines of railways, and the cost of transmission might be reduced to a figure as low or even lower than that obtainable with transmission lines. In a letter on railway electrification which appeared in our issue of April 11th, a well-known electrical engineer estimates the total cost of transmission on a 100-mile super-pressure 150,000-kilowatt cable system at .021 pence per unit, a figure which is remarkably small; but in this authority's opinion the use of super-pressure cables would make this result practicable. For many years past engineers have been working on the problem of raising the working pressures of electric cables. The first step in this direction was made in 1890, when Dr. Ferranti designed his 10,000-volt cables with a dielectric thickness of half an inch. The next notable advance was made between 1902 and 1903, when a cable system working at 20,000 volts was put into use on the North-East Coast. In 1915 30,000-volt three-core cables were laid for transmission in this country, whilst at the present time the cable manufacturers are prepared, we believe, to supply three-core cables for appreciably higher pressures, although no lengthy experience has been gained in this country with three-core cables working at pressures over 33,000 volts.

It is highly improbable that we shall ever need to raise our transmission pressures to the values which the Americans are now using on their transmission lines. Still, if long distances are to be covered and if large quantities of power are to be transmitted over them, a pressure of 100,000 or even more volts may prove desirable. We need not deal here with the technical difficulties which are associated with the construction and operation of super-pressure cables or with the reasons why the problem is simplified, so far as the line is concerned, by employing high-pressure direct current. Most engineers, we suppose, agree that direct-current offers advantages from the point of view of transmission, and if it could be produced by the generators in the power-house, as it was in the early days, and could be easily and efficiently converted into alternating current or lower pressure direct current, with an arrangement comparable in size, first cost, efficiency, simplicity, and reliability with the static transformer, there is no doubt that it would be used on an extensive scale. But, in our opinion, even the most modern developments do not give the simplicity and efficiency that is desired, and the fact that the Americans are experiencing certain difficulties with their super-pressure systems is no reason why British engineers should assume that the only way out of the difficulty is to use direct current. Dr. Ferranti had plenty of trouble when he first attempted to transmit alternating current at 10,000 volts, but he grappled with the difficulties and overcame them. No doubt the proposals in connection with direct-current transmission will be properly investigated before any extensive scheme is put into use. At any rate, we hope so. Every case must, of course, be considered individually; but, taking a general view of the matter, we fail to understand how any existing high-pressure direct-current scheme is going to prove a serious competitor to the alternating-current system, when large quantities of power have to be dealt with.

Quite apart from the additional losses associated with the apparatus at the transmission and receiving ends—losses which incidentally may represent a very considerable sum of money—there would appear to be a very fair additional outlay on plant, not to mention running charges, and how far the advantages of the direct-current line would counterbalance these additional expenses and trouble is a matter on which many engineers would no doubt like to have information. As there are no 100,000-volt alternating-current cables there is no proper basis for comparison. It does not follow, however, that there will never be any super-pressure alternating-current cables. A system of alternating-current transmission which we should like to see tried on a large scale and compared with the latest direct-current proposals is the Hexaphase system, which is claimed to be capable of transmitting current at 120,000 or 150,000 volts without the stresses on the insulation reaching appreciably higher values than those existing on 33,000-volt cables. The development of super-pressure cables by the use of graded potential intersheathes such as are employed by the inventor of this system may possibly overcome the problem of cheap and reliable transmission and so render rectification unnecessary. We are in no way antagonistic towards direct-current transmission. It undoubtedly offers certain advantages, such as the elimination of inductive and capacity effects, which, however, can be grappled with. On the other hand, we cannot generate high-pressure direct current in the power-house, and it will not be easy, we think, to persuade engineers who have to transmit really large quantities of power to convert all the current at both ends of the line.

Institution of Mechanical Engineers.

IRRIGATION PUMPS IN THE SUDAN.

THE Institution of Mechanical Engineers met on Friday, the 9th inst., at Storey's-gate, to discuss a paper by Mr. R. W. Allen, entitled "Irrigation Pumping Machinery (Gezira Scheme), Sudan," of which we give a *précis* on page 549. Mr. Patchell, the president, presided.

Mr. Allen read his paper at length and subsequently showed a number of lantern slides, on which he passed a running commentary that added very materially to the interest of the meeting, showing plainly, as they did, some of the difficulties which have to be overcome in engineering work on the banks of a river subject to great floods and under a sun nearly perpendicularly overhead. Incidentally he remarked that although the contractors put up shades to protect the native workmen from the direct heat of the sun, the men preferred to do without them. Mr. Allen also emphasised the necessity for carefully choosing the site of buildings, especially pump-houses, near rivers which have a habit of changing their courses.

Mr. Roger Smith opened the discussion and remarked on the courage of the engineers in installing Diesel engines as large as 1000 horse-power so far away from the nearest engineering establishment as those at Wad-el-Nau. They had, however, justified the trust placed in them. He had seen the pumps at work, though, as Mr. Allen mentioned, one was intended to be a "stand-by," all three of them were frequently run simultaneously. The water delivered there amounted to 21,000 tons an hour, but even that quantity was small by comparison with that which would be available when the Makwar (Sennar) dam was completed. In December last he had seen the 30,000 acres which are now being irrigated by pumping covered with cotton in full bloom. Mr. Smith made some remarks about the labour employed on the plantations, which, he said, was supplied, not by the local natives, but by the West African Mahomedans on their pilgrimages to Mecca. He deplored the fact that throughout the Sudan there were hardly any British motor cars and urged English engineers to study the country as a market. The officials there were sympathetic towards the home manufacturers, and there was a good opening for a suction gas producer burning charcoal, while the great number of oil engines already in service in the country suggested the need for a cheap change-speed gear, so that the engines could be used for driving various classes of machinery.

Mr. Hobson, who followed Mr. Roger Smith, confined his remarks chiefly to praise of the Sudan Government Railways and the Government itself, to both of which, he said, great credit was due on account of their efforts to increase enterprise throughout the country. He knew that great things were expected of the Gezira when the dam was completed, and said that the pumping scheme had the great advantage that it enabled experience to be gained as to the local conditions of cultivation, pending the completion of the dam.

Mr. Deane said that he had had considerable experience with large pumping plants and had noticed that the run of the suction piping was not generally given as much attention as it had evidently received at Wad-el-Nau. A common arrangement was to drop the suction pipe vertically into a trench, with the result that the velocity attained by the water in flowing along the trench was dissipated by the right-angled turn into the pipe. In the arrangement described by the author, however, the flow of the water was as nearly straight as possible. He would have been glad had the paper given the overall efficiency of the plant, but that could not, of course, be obtained without a meter. It would, however, be no very great matter to install Pitot tubes or a diaphragm orifice for measuring the water. He asked what the night temperature at the station was. Although the day temperature was as high as 145 deg., he believed that radiation was so intense at night that ice formed on exposed water. He would also like to know what class of fuel oil was best suited for use at such high atmospheric temperatures.

Professor Baker said that he had had some experience with expansion joints in water mains laid in hot countries, where the temperature might vary daily between 115 deg. and 0 deg. Although there might be a movement at the joint of as much as 4in. or 5in. during erection, when the pipe was exposed there was practically no movement when the pipe was covered with soil and full of water.

Messrs. Livens, Pendred, Dalby and Patchell also spoke, and the author briefly replied to the discussion. He said that the reason why meters were not installed on the pump deliveries was that the Government wished to economise; but Venturi meters had since then been ordered and were now complete. The calculated efficiency of the plant was 82 per cent. The night temperature was, he said, some 25 deg. below the maximum of the day. As to the fate of the pumping plant when the Makwar dam was completed, it was not possible to forecast; but the fact that all three pumps had been running continuously ever since December suggested that they might still be needed even with the dam in commission.

The Royal Society Conversazione.

ON Wednesday evening the Royal Society held its annual conversazione at Burlington House, London. The exhibits were more than usually of a medical or anatomical nature, and there were few of direct engineering interest.

The National Physical Laboratory exhibited an electrical method of hardening the ends of standard gauges, whereby the hardening is confined to a layer about $\frac{1}{4}$in. in depth at each end of the gauge.

The methods of hardening steel gauges in which the whole of the gauge is hardened are attended with the possibility of the production of gauges having unequal coefficients of thermal expansion. If the hardening process be confined to a thin layer in the end of the gauge, the uncertainty produced by hardening may be reduced approximately in the ratio of the depths of the hardened layers to the length of the gauge. The hardening is produced by making the gauge one electrode in a circuit which includes three graphite resistors. When traversed by a current of about 750 ampères (alternating current) the contact resistance at the two surfaces of the central graphite resistor produces a very considerable heating effect, and a high temperature in the central graphite. This heat is conducted to the end of the gauge, which is thus heated up to a temperature slightly above the critical temperature. The breaking of the electrical circuit is then made to drop the gauge into cold water, where the rapid cooling of the end of the gauge results in its hardening to a depth determined by the distance the heat has penetrated the gauge.

The Laboratory also showed an all-metal annular-jet vacuum pump suitable for adaptation to workshop conditions for exhausting X-ray tubes, thermionic valves and other apparatus. With this pump, we were informed, pressures as low as one four hundred thousandth of a millimetre of mercury have been realised. The pump is of the mercury-vapour type and represents an attempt to combine the advantages of the jet and condensation principles in a single and readily accessible unit. The pump, which incidentally is free from welded joints, will readily produce a vacuum of the order of 0.00001 mm. mercury or less when working against a back pressure of 1 mm. mercury. The annular jet has a total area of nearly 3 square centimetres and the speed of pumping is high, the value (which varies between 1000 and 7000 c.c./sec.) depending on the pressure conditions.

By means of a most interesting equipment the Anglo-Persian Oil Company demonstrated the phenomena of the selectivity of lightning discharges. The apparatus was evolved in the course of an investigation into the best methods of protecting oil storage tanks from lightning. It consists of a circular table strewn with sand or other earth substance, above which at a variable height there is rotated a discharging point carried at the end of a power-driven arm. The discharging point is connected to a source of high-tension electricity, the pressure of which can be varied from 200,000 to 500,000 volts. The base of the table is metal, and through it a return is provided for the energy discharged to the "ground." Metallic washers are placed on the sand to represent oil tanks, and as the arm passes over them the nature of the discharge which occurs is observed with due regard to the presence or absence of protective devices. As demonstrated to us, it was shown that a group of four "tanks" might readily be fired by a discharge of lightning in their neighbourhood as a result of a corona effect or secondary discharge spreading from one to the others. If one tank were

provided with a point representing a lightning conductor it would attract the discharge wholly to itself. A properly earthed conductor placed in the middle of the group of tanks protected them all. It had been deduced, we were informed, that a conductor 50ft. high would afford protection over an area ¼ mile in diameter.

Professor Gerald Stoney and Mr. J. P. Chittenden, of the English Electric Company, showed a model designed to demonstrate the vibration of steam turbine discs and shafts. In the model as shown to us, light from a "pointolite" lamp was projected through a pin-hole on to a mirror at the end of a model turbine shaft, which could be run up to a speed of about 4600 revolutions per minute. The light from the mirror was reflected back through a lens on to a ground glass screen. At low speeds the image of the point of light thrown on the screen took a circular form, but when the speed was increased up to half the first critical speed the image assumed an irregular form. Thereafter it again became circular, until the first critical speed was reached, when it elongated into an ellipse, which rotated its axis in the clockwise direction. Subsequently, as the speed was still further increased, the image assumed a variety of most complicated forms as the shaft passed through different critical conditions. When the speed was lowered, the image passed through the same series of forms in the reverse order and at corresponding speeds.

The International Western Electric Company exhibited a method of producing an even time scale by using a neon lamp for the inspection of wave forms with the cathode ray oscillograph. The vertical line produced on the oscillograph screen by the alternating potential, whose wave is to be inspected, is spread out horizontally by impulses of a periodic linear character produced from a circuit in which a neon lamp is arranged to "blink." The impulses from the neon lamp circuit may be simply synchronised with the frequency of the supply examined, so that a stationary representation of the wave is obtained. The method is suitable for waves of frequency 1 to 25,000 p.p.s, and may be used up to 50,000 p.p.s.

The Cambridge Instrument Company showed a torsionmeter, invented by Mr. E. B. Moullin. In this torsionmeter an ammeter gives a direct reading of the mean torque over a 4ft. length of shaft of any diameter, or a continuous photograph of the instantaneous torque can be taken by means of a Duddell oscillograph. Two saddle pieces are clamped to the shaft at a fixed distance apart, one of which carries a laminated armature and the other an electro-magnet, the position of the armature being so arranged as to be close to the electro-magnet. A magnetic circuit is thus set up through the armature and the magnet core with only a small air gap. When power is transmitted by the shaft, any torsional movement in the length between the two saddles causes variations in the air gap between the armature and the core, and the design of the electro-magnet is such that its reactance and the air gap are connected by a linear law. Through the electro-magnet winding is passed alternating current supplied from a generator giving an electromotive force bearing a constant ratio to the frequency. Hence the current through the electro-magnet is independent of the voltage, and gives a direct measure of the twist or torque in the shaft.

Obituary.

CHARLES EUGENE LANCELOT BROWN.

It is with much regret that we have to announce that Mr. Charles Eugene Lancelot Brown died at his home in Montagnola, near Lugano, on the second of this month. A full account of the great part which he took in the development of electrical engineering, when acting first as director of the electrical department of the Oerlikon Company, and later as technical administrator of Brown, Boveri et Cie., would occupy many of our columns. He was born in Winterthur in June of 1863, his father, Charles Brown, being an engineer of exceptional ability who for some years devoted his energies to the perfection of the steam engine in the works of Sulzer Brothers. At the age of twenty-one Brown joined the Oerlikon Company, and two years later he became director of the electrical department. Whilst with this firm he did much useful work in connection with the development of the direct-current dynamo and electrical transmission. He also developed numerous protective devices for use in conjunction with his installations, such as lightning arresters and automatic circuit breakers, which avoided breaking the current suddenly, but which cut down the field current of the generators when the line current increased beyond a certain value.

Among the early electrical schemes for which Mr. Brown was responsible was one in Italy, which was designed to transmit 270 ampères at a pressure of 625 volts over a distance of 500 yards. Another early plant which he designed was that for the Schaffhausen spinning mills, where he installed compound-wound generators and motors. The distance between the generating station and the mills was 750 yards, and over that distance the current from two generators, representing 600 horse-power, was transmitted. Whilst with the Oerlikon Company he also designed dynamos giving 12,000 to 13,000 ampères at 12 to 15 volts for use in connection with the manufacture of aluminium and aluminium alloys at the works of the Swiss Metallurgical Company in Neuhausen. In 1889 he designed for the same company the first vertical shaft generator.

In the field of direct-current electric traction he did some very useful and ingenious work, being responsible, among other things, for the design of the electrical equipment of the Heilmann locomotive, which was built in 1892. His direct-current work, which was done in the latter half of the eighties, was, however, in a large measure eclipsed by his work on alternating-current machinery. In this field his ability and genius, his enterprise and boldness, found a wide and congenial sphere of activity. Whilst still connected with the Oerlikon Company he took up the design of transformers and alternators for the generation of single-phase current. He was responsible for the direct-coupled exciter, and in later years, when Brown, Boveri et Cie. began to manufacture turbines under licence, he originated the cylindrical rotor for turbo-alternators, which is now used by all builders of high-speed alternating-current machines. His early engine-driven alternators were operated in Kassel, Germany, on one of the first single-phase transmission systems. Apparently he was the first to use oil for the insulation of transformers. Testing transformers which he used in the Oerlikon Company's works as far back as 1890 were worked at 40,000 volts without the slightest hitch, and they enabled him to carry out a series of experiments which terminated in the erection of the Lauffen-Frankfort installation.

The Lauffen transmission scheme which was established was as a matter of fact much more than an experiment. It was a daring and successful demonstration, not only of the utility of high voltages in connection with the transmission of power, but also of the value of polyphase currents, and it marked an epoch in the commercial development of electricity.

In 1891 Mr. Brown also designed a new type of alternating-current generator, which was much more like a real piece of engineering work than anything of the same kind which had previously been constructed. He very soon recognised, however, that his machine was defective and he ceased to build it; but others, who did not recognise the defect, namely, considerable field leakage, continued to construct the machine long after its inventor had discarded it.

In 1891 Brown founded the firm of Brown, Boveri et Cie., and in the new works at Baden he devoted all his energies to the practical development of alternating-current machinery. Again, he paid much attention to the revolving field type of alternator, as used at Lauffen, ultimately making it a thoroughly successful machine. In the hands of Brown the revolving field generator received its modern form and shape, the previous machines being very wide and they were very imperfectly ventilated. Brown designed the machines for the Cataract Construction Company, Niagara Falls, and for the Frankfort Electric Central Station in Germany, those at Frankfort, it is said, being the first to draw attention to the system of winding the fields with copper strip on edge.

In the design of the Frankfort generators, he used for the first time the rigid and stiffly constructed end housings which support the armature, centre it, and allow the armature to be turned into any position for the purpose of repair. Early in the history of alternating-current electrical engineering he grasped the idea of working an alternator slightly beyond the bend of the saturation curve, an idea which he put into practice. Early in 1890 he designed his first induction motors with tunnel windings on the stator and rotor. In 1892 he patented his double layer winding, whilst in 1897 he designed a 1000 horse-power two-phase motor for direct connection to a centrifugal pump in Geneva.

In 1894 he conceived the idea of working railways with polyphase current, a scheme which he subsequently put into practice for the first time in Lugano. Later he adopted the system on his railway upon the Gorner Grat, near Zermatt, and on the locomotives which he designed for the Jungfrau Railway, and finally on the trunk railway between Burgdorf and Thun.

His work was unquestionably of tremendous value to the whole of the electrical profession. In Switzerland he created a powerful industry, which gives employment to many workpeople, and his inventions have served to advance electrical engineering in many other countries. He retired from the firm of Brown, Boveri et Cie. in 1911.

FRANCIS JACOB.

By the death of Mr. Francis Jacob, at the age of seventy-one, which took place on the 7th inst., there has been lost to the domain of submarine telegraphy and telephony a very prominent figure.

Mr. Jacob was educated at Bedford Grammar School and King's College, where he was awarded the Siemens Gold Medal. He joined the firm of Siemens Brothers in 1873, and was for many years actively engaged in designing and laying submarine cables, including the following:—The Brazilian cable for the Platino-Brazileira Telegraph Company, 1873–4; the Atlantic cable for the Cie Française du Telegraphe de Paris a New York, 1879; the Atlantic cables for the Western Union Telegraph Company, 1881 and 1882; and the Atlantic cables for the Commercial Cable Company in 1884, 1894 and 1900; &c.

He was the inventor of the multiple twinning system for cables, which is now universally adopted, and also of numerous testing devices and apparatus, including the Jacob's relay for submarine telegraphy. He was one of the oldest members of the Physical Society, and was regarded as being among the greatest authorities on cables. He contributed the article on this subject in the "Encyclopædia Britannica." For many years he was the chief electrician at Messrs. Siemens Brothers' Woolwich works, and in 1914 was appointed the works general manager. He retired from the latter position in June, 1921, having completed nearly fifty years' service with the company.

Literature.

The Merchant Service in War: Seaborne Trade. Being a Part of the History of the Great War Based on Official Documents and Prepared by Direction of the Historical Section of the Committee of Imperial Defence. By Mr. C. Ernest Fayle. Volume III., covering the period of unrestricted submarine warfare. London: John Murray. 1924. One guinea net.

The third volume of Mr. Fayle's history of the economic side of the Merchant Service in War completes his series, which stands out as one of the most successful sectional histories of the war that have yet been published; certainly the most readable and praiseworthy of the three that go to make up the more or less official history of the War at Sea. In writing a history while the events in question are still fresh in the minds of the public an author is confronted with two alternatives, either he can give the facts as fully and impartially as possible, or he can write a complete history and give his ideas of the lessons taught by each occurrence. Mr. Fayle has chosen the former method, and one cannot help agreeing with him that he has followed the right policy. He contents himself with giving us all the difficulties with which the authorities had to contend in regard to shipping and showing how they were surmounted. That explanation refutes much of the criticism which was freely expressed during the war and puts many things in a very different light. The tolerably full accounts that we have of historical wars on commerce show the difficulties which they always bring in their train; but the progress that has been made with steam has multiplied these difficulties many times, and the wonder is that we got out of the trouble as well and as economically as we did.

This volume begins with the early operations of the Shipping Controller at the end of 1916, operations that rapidly grew until the various committees and officials who had been created became the Ministry of Shipping in full working order in April, 1917. That was an authority which had hardly been thought of before the necessity for it arose and, therefore, although it is easy enough to criticise its mistakes—and there is no hiding the fact that there were many—it had to work under a handicap which very few people realised but which is very clearly shown by the historian. Difficulty after difficulty cropped up and had to be overcome somehow, although it must frequently have been very hard to see the way out of the maze. The darkest hour was in April, 1917, when the unrestricted submarine warfare was beginning to show real results and our plans for replacing tonnage, a subject that had been hopelessly neglected in the rush to build men-of-war, had not yet borne fruit. Then came the liner requisition scheme, and finally the measure that should have been taken some time previously, the provision of convoys. The trouble was that the Admiralty was hard put to it to provide convoying craft even then. Mr. Fayle shows us how the convoy system rapidly lessened losses and at the same time how the efforts of the shipbuilders at home and abroad filled up the gaps with surprising rapidity—not the least interesting part of the story—so that by the time the Armistice came we had really found an efficient antidote to the submarine war. The two last chapters are devoted to the situation that immediately followed the Armistice and preceded the slump, and to an appraisement of the legacy of the war, and there the historian leaves us to form our own conculsions on the material that he has presented.

The Faraday House Old Students' Association held its annual smoking concert at the Hotel Cecil, Victoria Hall, on Friday, the 2nd inst. There was a very good attendance of past and present Faradians. The chair was occupied by the President of the Association, Mr. R. N. Vyvyan, M.I.E.E., and an excellent musical programme was provided.

New Dry Dock and Ship-repairing Yard at Swansea.

No. I.

ON Wednesday last the new dry dock adjoining the King's Dock at Swansea, which has been constructed for Palmers (Swansea) Dry Dock Company, Limited, was formally opened by Lady Pole, the wife of Sir Felix Pole, General Manager of the Great Western Railway Company.

Our readers will remember that, early in the year 1922 Palmers Shipbuilding and Iron Company, Limited, of Hebburn-on-Tyne, decided to form a ship-repairing establishment at Swansea, and for that purpose a subsidiary company was formed under the title of Palmers (Swansea) Dry Dock Company, Limited. The contract for building the dock was given to Sir John Jackson, Limited, in April, 1922, and subsequently contracts for the erection of various shops and office buildings in the ship-repairing yards were placed. Those buildings were completed early in last year.

The King's Dock was opened as long ago as 1909, and, with an eye to future developments, it was given an entrance lock which measures no less than 875ft. long by 90ft. wide, and has a depth at H.W.O.S.T. of 33ft. of water over its inner sill. It was realised, of course, that for the full equipment of the dock it would be necessary to have dry-dock accommodation of a capacity sufficient to meet the needs of the largest vessels using the port, and in designing the King's Dock a conveniently situated site was set aside for that purpose. It was the intention of the Swansea Harbour Trustees, who were then, and till 1923, the dock authority, themselves to build a graving dock on the site chosen. They did not, however, have an opportunity of carrying out their intention before the docks as a whole were acquired by the Great Western Railway Company, but it is on the precise piece of land which they set aside that the new dock and ship-repairing yard have been constructed.

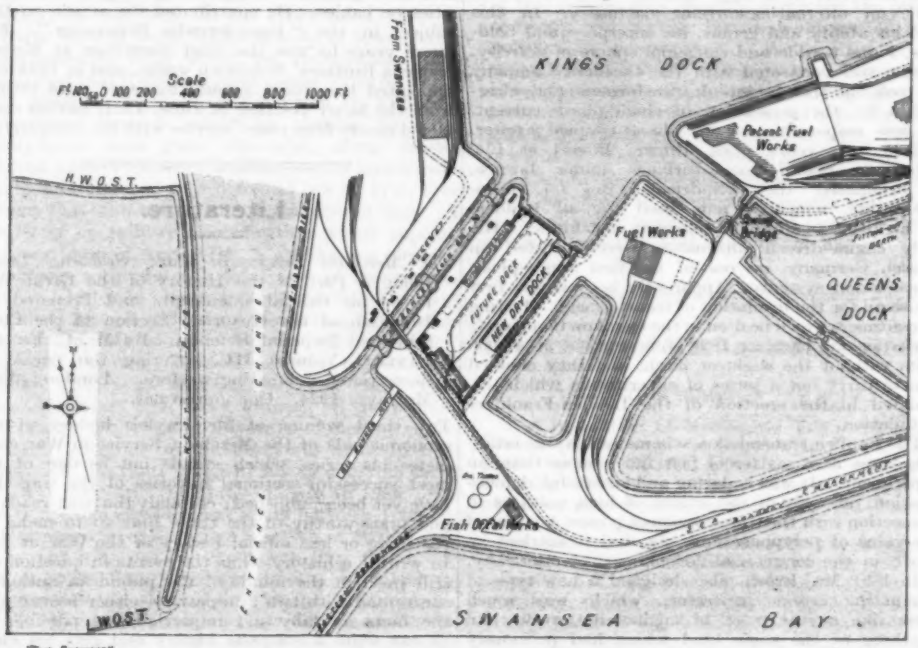


FIG. 1—PLAN SHOWING POSITION OF NEW DRY DOCK

As a matter of fact, though the Trustees did not build the dry dock, they did construct, provisionally, an entrance through the King's Dock wall, the space between the roundheads being filled, temporarily, by a wall built of concrete blocks, with a brickwork and concrete superstructure, which could, when the dry dock came to be constructed, be removed without serious difficulty.

The chief dimensions of the new dry dock are :—

Internal length	560ft.
Clear width of entrance	75ft.
Depth of water on sill at H.W.O.S.T.	26ft.

The width—75ft.—is the largest clear width of entrance of any dry dock in the Bristol Channel ports—with the exception of the dry dock at Avonmouth, which is 100ft. wide—and is larger than that of any dock in South Wales or Monmouthshire, but the length is not so great as that of some other Bristol Channel docks. However, there is room to extend the length of the dock when lengthening becomes necessary, and the end wall has been built with concrete block in a temporary manner. Furthermore, there is room to form near to, and parallel with it, another and larger dock, which has a designed length of 680ft. and a clear width at the entrance of 80ft. It will be observed that even the proposed larger dry dock is 195ft. shorter and 10ft. narrower than the entrance lock to the King's Dock. We may say in passing that up to the present the largest vessels ordinarily using the King's Dock are of some 10,000 tons, or just over, and have lengths of between 480ft. and 500ft., and beams of between 60ft. and 65ft. It will be seen, therefore, that the dimensions of the new dry dock are such as to allow of a considerable increase in the size of the vessels frequenting the port before an extension in length will become necessary.

The water level of the King's Dock is maintained, normally, at the level of high water of ordinary spring tides, and does not fall more than about 5ft. below that level, so that ships are able to enter and leave the dry dock at any state of the tide. We understand, moreover, that the Great Western Railway Company intends to lay down a pumping plant for the purpose of maintaining the water level in the King's Dock and Prince of Wales' Dock systems at the level of high water of spring tides. When that pumping plant has been installed the depth of water over the dry dock sill will be maintained constantly at 26ft.

The works comprised in the King's Dock system, which includes the Queen's Dock, were constructed upon an area of foreshore which was reclaimed by the construction of a sea embankment. The position of the new dry dock with reference to the King's Dock, and to the entrance channel from the sea, will be gathered from an examination of Fig. 1, while the general design of the dock and the arrangement of the ship-repairing shops will be seen in Figs. 2 and 3. The area of the two wet docks, together with the subsidiary docks in connection with them is about 250 acres. At the site of the dry dock the original foreshore level was about 18ft. below high water of ordinary spring tides, or some 10ft. above the low water level of ordinary spring tides. The area lying between the south quay wall of the King's Dock and the sea embankment had not, at the time of the completion of the King's Dock works, been completely filled with material excavated from the dock bottom, and when the construction of the new dry dock was commenced in 1922 a large portion of the site now occupied by the ship-repairing yard and the dry dock was submerged, the water level standing in the unfilled area at a level of a few feet below high water of ordinary spring tides.

The contractors were therefore faced with the necessity of cutting off the site to be occupied by the dry dock from the remainder of the flooded area before constructional work could be proceeded with. For this purpose a line of Ransome patented Type D steel sheet piling was driven on the east side of the site extending from the King's Dock wall for a distance of 866ft. southward towards the sea embankment. A timber gantry was then constructed on a line parallel with the sheet piling, and on it were carried the piling cranes and the travelling steam cranes which grabbed material from the area which was to

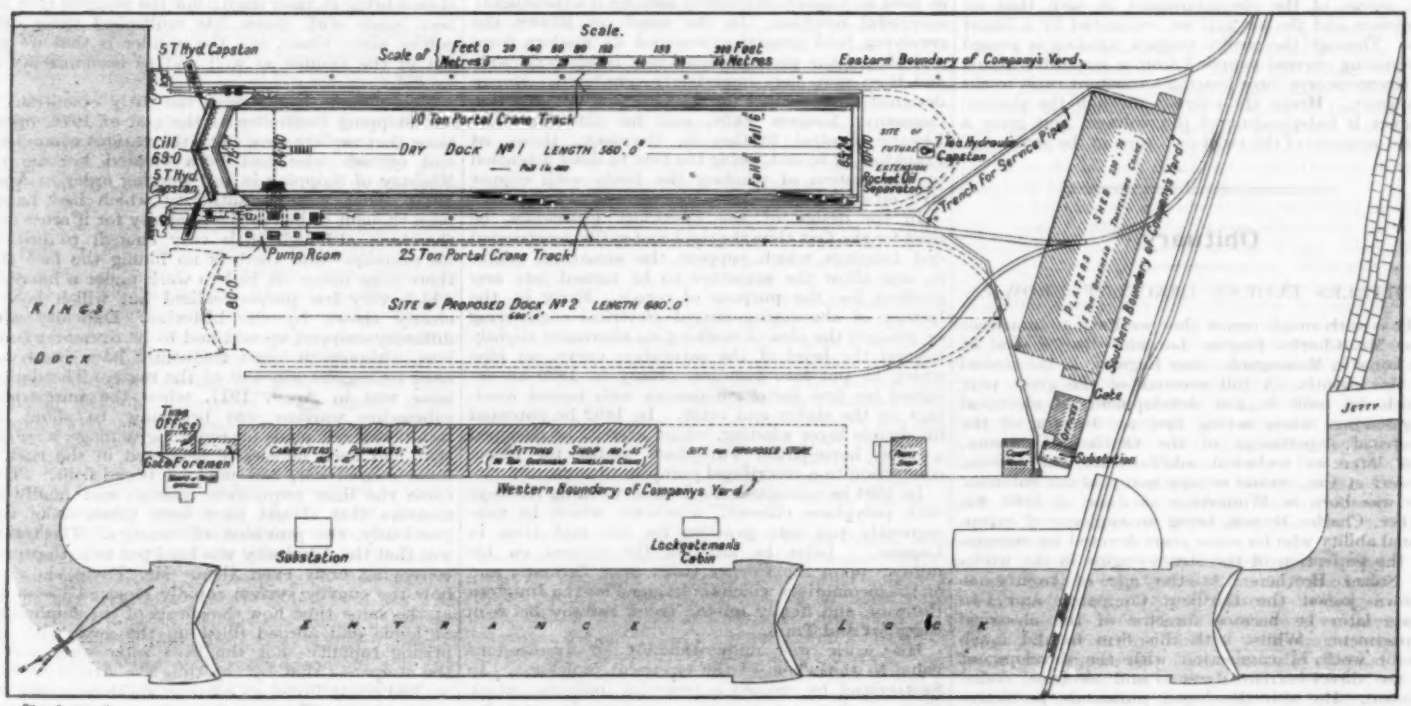


FIG. 2—PLAN OF NEW DRY DOCK AND WORKSHOPS

be dried out, and deposited it on either side of the piling to serve as backing. The piling was driven, on the average, to a depth of about 6ft. into the original foreshore, which consists of mud and gravel with small boulders. A certain amount of clay and loam was found mixed with the gravel in some parts of the work.

After the construction of the sheet piling dam had been completed, and the enclosed area pumped out, the excavation for the walls of the dock were proceeded with, both on the east and west sides, timber staging being constructed for the purpose of carrying travelling derricks, wagon roads, and concrete mixers. Excavation, generally, was carried out in the open down to the level of the original foreshore. Below that level the excavation for the side walls was effected in timbered trenches. The concreting of the side walls of the dock was put in in sections of about 60ft. in length, a vertical V joint being formed at the junction of adjoining sections. When portions of the side walls on both sides of the dock had been taken up about half-way, the remaining portions of the dumpling between the side walls were excavated down to a level of about 3ft. above the finished floor level. The excavation for the floor, sill and apron was then proceeded with in alternate sections, each 20ft. wide, excavation being carried down in timbered cross trenches, extending across the dock from wall to wall. The excavation and concreting of the intermediate sections was effected after the concrete had been deposited in the adjoining sections.

Before the concrete block wall at the entrance to the dry dock could be removed, a cofferdam, enclosing the future entrance, had to be constructed in the King's Dock. This cofferdam was formed of Ransome steel sheet piling of a type identical with that used for the line of piling to the east of the dry dock. The piling was driven into the dock bottom and was supported by timber strutting from the King's Dock wall and the temporary concrete block wall. When the latter was removed, the struts which had been supported by it were taken out, and long diagonal struts substituted, the latter butting on the concrete fender piers which had, in the meantime, been constructed in the entrance.

Work on the site of the dry dock was begun by the constructors on April 21st, 1922. The steel sheet piling dam on the east side of the site was completed in August, 1922, and the King's Dock cofferdam in December of the same year. The construction of the concrete walls of the dry dock was begun at the end of December, 1922, and the whole of the concrete work in the body of the dock was finished in February of this year. The entrance gates were completed and the removal of the King's Dock cofferdam was begun on April 4th last.

During the progress of the works pumping on the site of the dock had to be carried on continuously. The standing water level in the ground surrounding the site is about 5ft. below H.W.O.S.T., while the underside of the floor of the dock is placed at a level of 43ft. below that level. It was sometimes found necessary to employ three 12in. centrifugal pumps, in addition to a few smaller pumps for de-watering the site. For the greater part of the time, however, two 12in. centrifugals were sufficient to deal with the inflowing water.

The new dry dock—views along which are given on page 540—is constructed entirely of concrete, saving that the hollow coins and sill stones are of granite, all the granite being obtained from Messrs. Freeman's quarries near Penryn, Cornwall. The dock gates—see Fig. 5—are of steel, and they are opened and closed by means of hydraulic machinery. They are of the semi-buoyant two-leaf type, air-chambers being constructed in the lower part of each leaf. The upper part of each leaf consists of a water ballast chamber into and out of what the water is free to flow as the level of the water inside the dock rises or is lowered. The castings for the heel pivots, bottom sockets and top pivots are of steel. No rollers are fitted, and the total unbalanced weight of each leaf is approximately 18 tons. The gate anchorages are, however, designed to be of sufficient strength to carry the gate when swung in the dry or with all the air compartments filled with water. The total weight of steel work in each leaf of the gates is approximately 80 tons, and the swinging weight of each leaf, including the timber fendering, gangway, &c., is 100 tons. The hydraulic gate operating machines have cylinders 10in. in diameter. The hydraulic power for operating them is taken from the Great Western Railway Company's power mains at a pressure of 750 lb. per square inch. The same source of power is also used for working two 5-ton hydraulic capstans, one on each side of the dock entrance, and will also be employed for a 7-ton capstan which is to be placed at the inner end of the dock. The constructors for the gates and hydraulic machinery, including the capstans, were Sir W. G. Armstrong, Whitworth and Co., Limited.

The floor of the dock has a fall from the inner end towards a drainage sump arranged near the front or gate end of 1 in 400, and a cross-fall of 6in. from the centre line to each side. The drainage gutters at the sides fall 1 in 300. The keel blocks are of cast iron with oak capping blocks and soft wood liners. The cast iron blocks are made in three sections, and are tapered and machined on the meeting faces. The blocks are set on pitch pine bearers laid longitudinally under the blocks, which are spaced 3ft. 3in. apart, centre to centre. The total height of the blocks from the concrete floor to the top of the soft wood packing is 4ft. 6in. Mild steel cotter pins are provided for keying up the block sections. The blocks are designed for a maximum loading of 36 tons per lineal foot, measured along the centre line of the dock. They are mounted on the longitudinal timber bearers in groups of four, the bearers being discontinuous, so that, if repairs to a keel plate of a ship be necessary, a complete section of blocks can be unwedged and withdrawn without any cutting away being required as is necessary with the old-fashioned type of timber block.

The chamber containing the de-watering pumps is arranged on the west side of the dry dock, near the entrance gates, and the west wall of the chamber will form a portion of the side wall of the larger

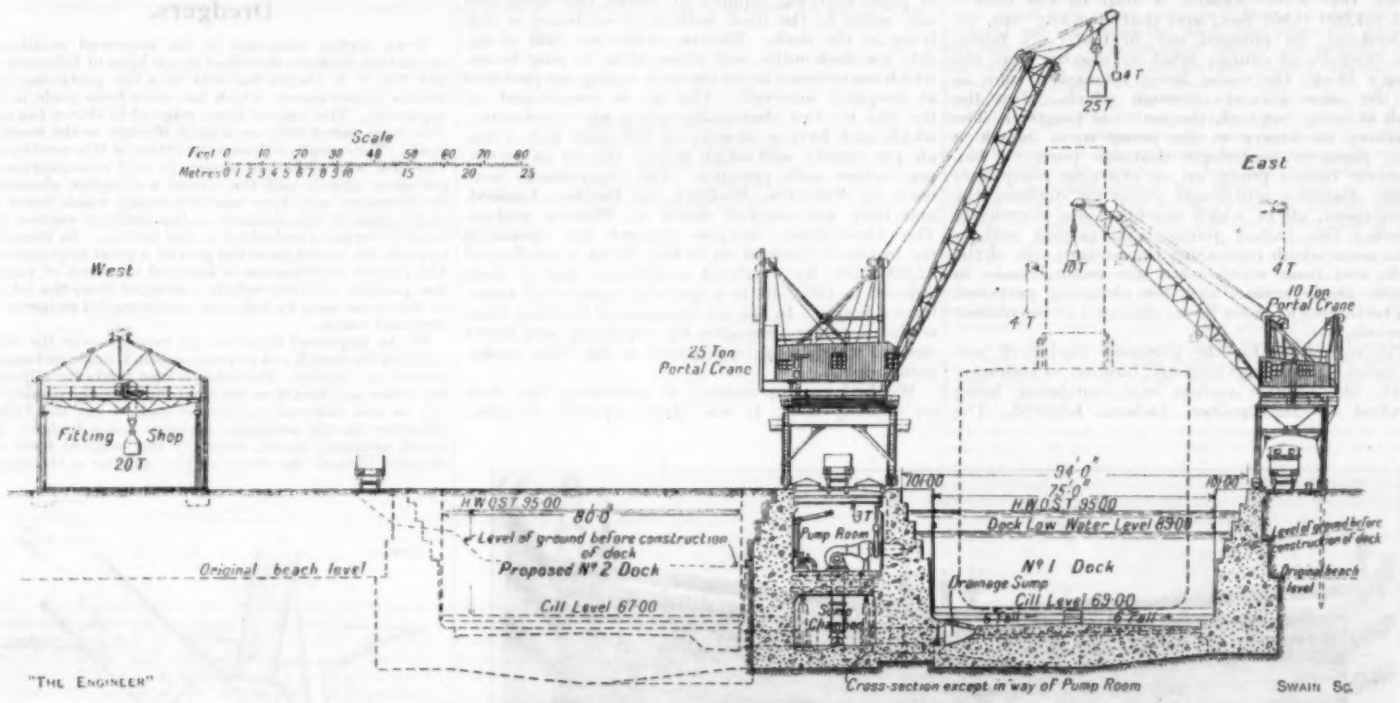


FIG. 3—CROSS SECTION THROUGH FITTING SHOP, PUMP CHAMBER, AND NEW DRY DOCK

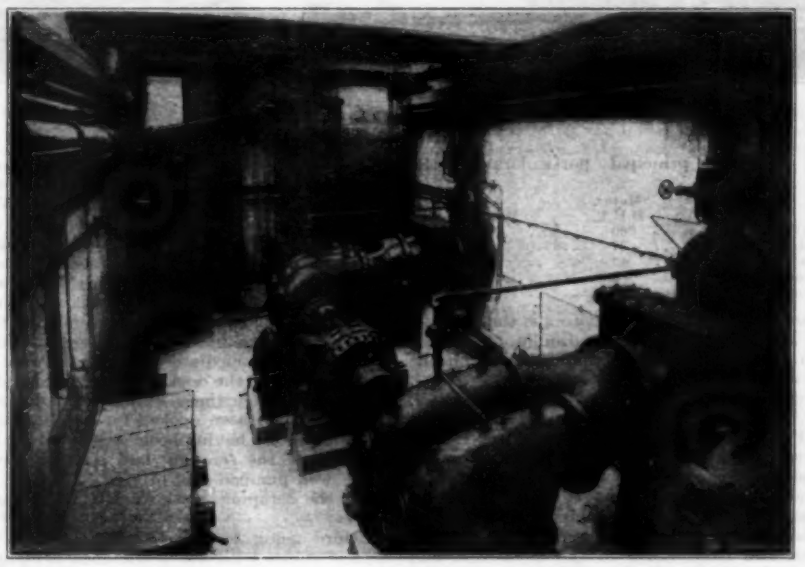


FIG. 4—INTERIOR OF PUMP CHAMBER

dry dock when it is constructed. The whole of the pump chamber—a view of the interior of which is given in Fig. 4—comes below the coping level of the dock, access being obtained to it by a flight of stone steps. It is well illuminated by skylights. Underneath the pump room is a sump chamber which communicates with the dock by means of two cast iron culverts 54in. in diameter. When the second dock is constructed, the inner ends of these culvert pipes will be fitted with hydraulically-operated sluice valves, which will be operated from the pump room, and similar valves will be placed on the inner ends of the culvert pipes communicating with No. 2 dock. The pumping plant

will thus be available for de-watering the second dock.

The pumping installation consists of two 36in. diameter centrifugal pumps, of the twin impeller pattern, which discharge into a cast iron delivery culvert 54in. in diameter. The sluice valves on the pump discharges, as well as those on the filling culverts, are operated hydraulically. "Stand-by" hand-operated penstocks are also fitted in all the culverts. Each of the main pumps is driven by a 280 brake horse-power electric motor. The total water content of the dock at high water of ordinary spring tide level—without a ship in the dock—is 1,364,000 cubic feet, and that quantity can, we understand, be pumped out in under 2½ hours. The dock is, of course, filled by gravity from the King's Dock, the water being allowed to flow in by the same culverts through which, when the dock is being emptied, the water is pumped. The auxiliary machinery in the pump room include a 10in. diameter centrifugal drainage pump, a 9in. diameter ballast pump, an air charging pump, and a 2in. diameter centrifugal pump for draining the pump-room, all of which machines are electrically driven. The ballast pump is connected with a 10in. main which runs along the western side of the dock, and from which water for testing tanks in vessels under repair, and for cleansing purposes, can be tapped at valve boxes arranged at convenient intervals.

The contractor for the pumping machinery was Gwynnes Engineering Company, Limited, of Hammersmith, the electric motors and switchgear being supplied by Metropolitan Vickers, Limited. The ballast main. The fresh water and the steam pipes, as well as the hydraulic main, are 4in. in diameter, while the compressed-air main is 6in. in diameter. On the air mains, in addition to flanges for the connection of large branch pipes, a distribution box, with unions for flexible pneumatic hose is provided on the face of the dock wall abreast each valve pit. A branch air main, on which is arranged a number of distribution boxes, is also fixed to the side wall of the dock on its west side near the floor of the dock. Valve pits are constructed at intervals along the dock side for the attachment of pipes carrying supplies of steam, and fresh and salt water to the dock bottom or on board a ship lying in the dock. Electric cables are laid alongside the dock walls, and connections to plug boxes, which are recessed under the wall coping, are provided at frequent intervals. The air is compressed on the site by two electrically-driven air compressors, which each have a capacity of 500 cubic feet of free air per minute, and which deliver the air at 100 lb. per square inch pressure. The compressors were made by Fullerton, Hodgart and Barclay, Limited, and they are coupled direct to Phœnix motors. The three-phase 50-cycle current for operating the motors is brought on to the site at a pressure of 12,000 volts by overhead conductors, and is there reduced to 440 volts in a specially constructed transformer house. In the air compressor building there is also a motor generator for supplying and direct current which may be required in the ships undergoing repair.

We had an opportunity of examining the dock on Monday last. It was then emptied of water.

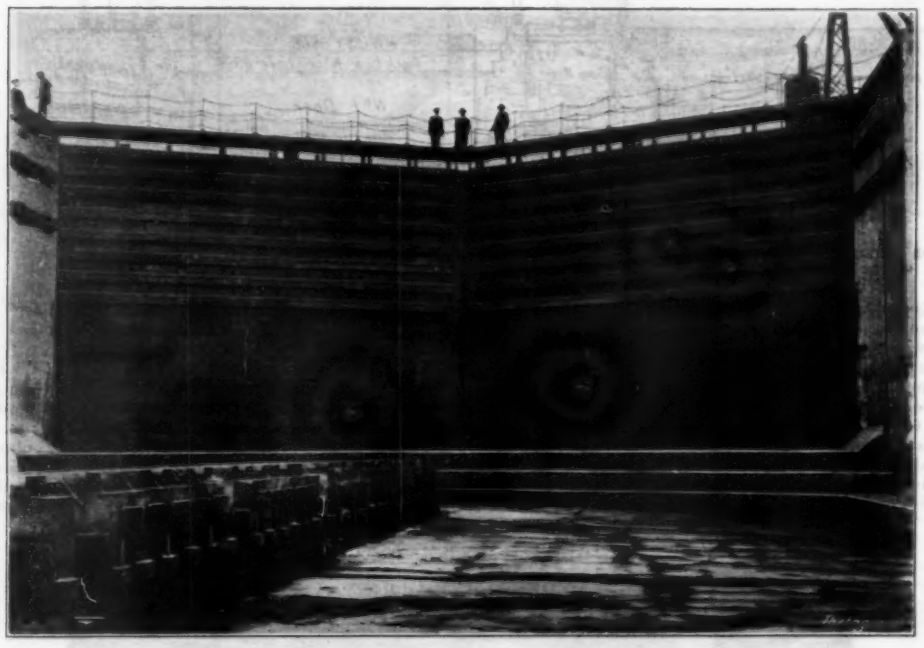


FIG. 5—THE GATES CLOSING THE DRY DOCK

following are the principal particulars of the motors :—

Pump.	Motor. B.H.P.	Speed. Revs. per min.
Main (2)	280	490
10in. drainage	37	722
9in. ballast	42	960
Air charging	5	1440
2in. pump-room drainage	2.5	1410

The current supply for all the motors is three-phase, 50-cycle at 440 volts. The hydraulic and other valves in the pump-room, as well as those on the culverts and the penstocks, were supplied by J. Blakeborough and Sons, Limited, of Brighouse, Yorks. An interior view of the pump chamber is given in Fig. 4.

The arrangements provided for supplies of water, compressed air, steam, &c., for use in connection with ships under repair, are very complete. A pipe trench has been constructed behind the west wall of the dock, and in it are laid pipes for supplying air, steam and fresh water to the dock side, and also the hydraulic supply mains for operating the gates. The 10in. diameter salt water ballast pipe, of which mention has already been made in connection with the ballast pump, is laid alongside the pipe trench. Water is pumped direct from the wet dock into this pipe and delivered under a head of 60ft. The ballast pipe can also be used for conveying oily water from the dock bottom—a branch connection with the drainage pump being provided for that purpose—and for the discharge of oily water direct from ships' tanks by means of branch connections on the dock side. Near the inner end of the dock a "Rocket" oil separator, which is designed to deal with 50 tons of oily water per hour, has been installed. This apparatus, which, by the way, is one of Messrs. Palmers specialities, is connected by means of a branch pipe with the

The actual opening ceremony on Wednesday consisted in the docking of a steamer of 6847 tons, having a length of 430ft., a beam of 57ft., and drawing 14ft. of water forward and 16ft. aft. She is named the British Empress and belongs to the British Tanker Company. Only some 10 min. intervened between the time that Lady Pole moved the lever to actuate the gate-opening machinery and the time when the vessel was safely in the dock, and the gates again closed. The de-watering of the dock was then immediately begun. We were informed that, previously, the dock had been filled and emptied some half a dozen times, everything going smoothly. One vessel had been docked for scraping and painting, the process having been completed in 24 hours. In her case the scraping had been effected as the water was pumped out of the dock, men on rafts doing the scraping as the level of the water sank lower.

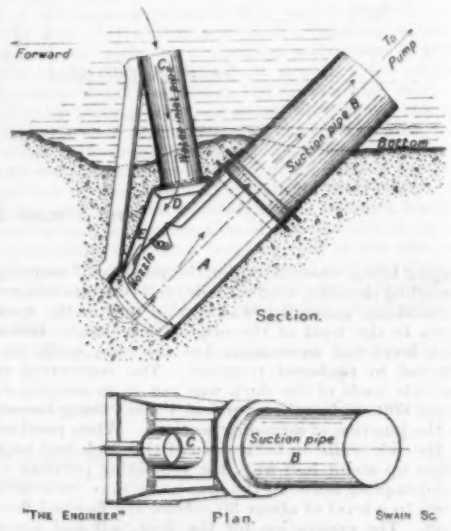
Before going on to describe the two excellent electric cranes with which the dock is equipped and the arrangement of the various shops forming the repairing works—which we propose to do in a second article—we may say that there is a berth 380ft. in length in the King's Dock just outside the entrance to the dry dock, which is available as a fitting-out berth. In addition, the company has acquired another fitting-out berth, 1200ft. in length, in the adjoining Queen's Dock, where a lay-by jetty for repairing purposes. This berth is of ample dimensions, and has alongside it a sufficient depth of water to accommodate the largest vessel which can enter the dock. It may be mentioned that the portion of the King's Dock immediately opposite the entrance to the new dry dock, is large enough to permit of the swinging of vessels, prior to docking them, to be carried out with ease. Access to the works may be obtained by road and by rail. A siding from the port system of the Great Western Railway makes connection with a network of lines laid throughout the works.

We may add, in conclusion, that Mr. N. G. Gedye, M. Inst. C.E., of Westminster, was the consulting engineer for the whole of the work, and that Mr. W. H. S. Tripp, M. Inst. C.E., was the resident engineer.

Improved Mouthpiece for Suction Dredgers.

WITH further reference to the improved mouthpiece for suction dredgers described in our issue of February 8th last, Dr. J. S. Owens has sent us a few particulars of a further improvement, which has since been made in this apparatus. The original form, referred to above, has since then been tested fully on a large dredger in the South of Spain. Two results followed the fitting of this mouthpiece. The first was a marked saving in coal consumption for the same output, and the second a complete absence of the vibration and other injurious results which follow the obstruction of the entrance of the ordinary suction pipe when it becomes embedded in the bottom. In these two respects the mouthpiece has proved a great improvement. The present modification is designed to permit of varying the quantity of water which is emitted from the jet and at the same time to leave an unobstructed entrance for sand and water.

In the improved form the jet extends over the whole width of the mouth and its cross section is made rectangular instead of circular. Provision is also made for adjusting the orifice and therefore the quantity of water passing the jet, to suit different conditions and to get the highest efficiency for the particular material being dredged. The jet of incoming water, which in the original form was directed towards the centre of the opening of the mouthpiece, is now arranged to enter at the top, and the nozzle is so designed that it does not obstruct the entrance of the mixture of sand and water to the suction pipe.



IMPROVED SUCTION DREDGER MOUTHPIECE

Referring to the accompanying drawing, a mouthpiece A is provided for the suction pipe B, and penetrating the top of the mouthpiece is an inlet pipe C which admits water to a chamber D in the floor of which is an adjustable nozzle E which directs the water on to the bottom.

The mouthpiece is constructed throughout of mild steel plates riveted together. It is rectangular in cross section and tapers in plan, so that the area of the passage increases as the mouth is approached. The mouth is fitted with the usual grating for preventing the entrance of solids too large to pass the pump, and the back end is provided with a flanged ring which may be drilled for attachment to the suction pipe.

The upper triangular portion of the apparatus forms a chamber, to the floor of which the nozzle plate is hinged so that the opening can be varied as desired. The adjustment is made by slacking the two nuts which grip the clamp plates, setting the nozzle plate as required and reclamping. Access to the nozzle plate for carrying out this adjustment is obtained through the grating. The water inlet pipe which penetrates the top of the water chamber is provided with a tie connecting it to the mouthpiece, which enables it to withstand the thrust when the mouthpiece is buried in the sand and the dredger is moving forward.

The operation of the apparatus is as follows :—When the suction pipe is lowered to the bottom, and the sand pump started, water enters through the inlet pipe C and is directed along the floor of the upper chamber D in the form of a rectangular jet, which impinges upon the bottom at the upper part of the mouthpiece. The water and sand then bend round and pass up the suction pipe, which, it will be seen, is now free of all obstruction to its entrance. The path of the water is indicated on the drawing by arrows. The improved form of mouthpiece is very similar to that described in THE ENGINEER of February 8th for application to the pumping out of loaded hoppers.

The whole appliance is very simple and can be attached to the existing suction pipe of any dredger.

THE five lifts at the Bank Station of the Central London and City and South London Railways were replaced by three escalators on Wednesday of last week.

Further Experimental Work on Diesel Engines.*

By ENGINEER-COMMANDER R. BEEMAN.

(*Continued from page* 518.)

EXPERIMENTAL WORK.

2. DETERMINATION OF A SUITABLE PROFILE FOR THE FUEL CAM ACTUATING THE SPRAYER.

THE important part played by the sprayer nozzle in the function of "injection of fuel" has been noticed. It is now proposed to examine the no less important question of obtaining a fuel cam profile which, in association with the particular mechanism adopted will ensure the correct actuation of the sprayer needle valve for dealing successfully with heavy fuel charges at the high speed of operation. It is not necessary in what follows to consider the actual shape of the fuel cam profiles, but rather the valve lift diagrams derived from them.

It will be appreciated that the rate and manner of the injection of the fuel has a vital bearing upon the resulting combustion, and that it is not sufficient merely to have the sprayer nozzle correct in all particulars; but it is also essential that the flow of fuel through the nozzle to the combustion chamber should be suitably regulated and timed in the manner to produce correct combustion results. A further point which may not be so readily appreciated, but which nevertheless has been established is that, whereas a certain fuel cam profile may give quite satisfactory results with heavy fuel charges at the lower speeds, it may be totally unsuitable for use at higher speeds; showing that the time element in the injection of the fuel, for which the fuel cam is responsible, is of vital importance, and its relation to the resulting combustion must be carefully considered. It was found, in the case of the Digit engine, in increasing the speed of engine to its designed limit, and employing the fuel cam and nozzle which allowed high mean pressures at low revolutions, that a very serious factor had to be faced, viz., detonation. The steps taken to eliminate this most undesirable feature, and the results of certain experiments with various fuel cam profiles fitted to the Digit engine will now be described. It may be stated that during the experimental work each fuel cam profile was tested in combination with several different nozzles, but it is proposed to note only the best results for each cam.

In the first place, it will be advisable to describe the valve lift diagram with which 159 lb. per square inch mean pressure at the lower speed of 285 revolutions was obtained during a test. This diagram, derived from the fuel cam in the manner to be described, is given in Fig. 7, whilst Fig. 8 shows the ordinary indicated work diagram taken with the same fuel cam in operation at the lower speed, and Fig. 9 gives the combustion diagram taken by the usual "displaced drive" method—obtaining under the above conditions. The procedure followed to obtain the valve lift diagrams—Fig. 7, &c.—is shown in Fig. 10 and is as follows. An ordinary piston indicator *a* is mounted immediately over the top of the fuel needle valve *b*, which is actuated by the fuel cam under examination. The end of the indicator piston *c* is placed in contact with and is actuated by a projecting spindle *d* screwed into the end of the fuel needle valve. In order to obtain a conveniently long diagram for purposes of comparison, a special pencil drum *e* is fitted over the ordinary drum, which is driven through the medium of the cord *f* from a crank, or excentric, set at an angle of 90 deg. to the main engine crank. The diagrams are taken whilst the engine is being barred round, and the 90 deg. displacement of the indicator driving crank has the effect of opening out the critical period in the lift of the valve, thereby facilitating the comparison of one lift diagram with another. It is convenient to take the actual fuel valve lift diagrams on tracing paper so that they may be superimposed and the result of any modification readily observed and compared. The lift diagrams obtained in the foregoing manner afford very valuable help in elucidating fuel-injection problems.

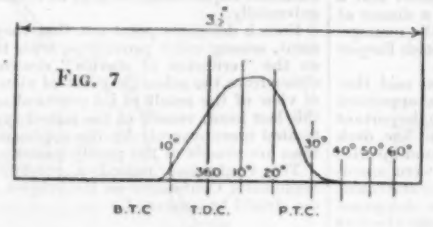


FIG. 7

VALVE OPENS 11° B.T.C.
·003" LEVER CLEARANCE
TOTAL PERIOD 58°
MAX. LIFT OF VALVE ·148"
CONTROL POSITION 10

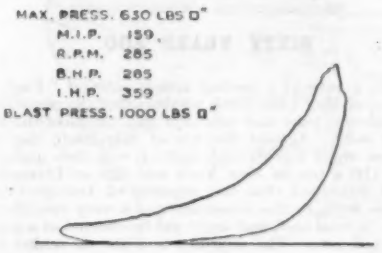


FIG. 8.

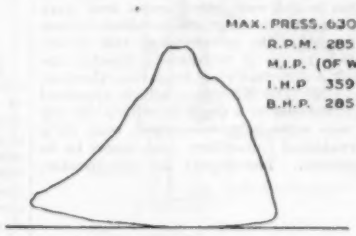


FIG. 9.

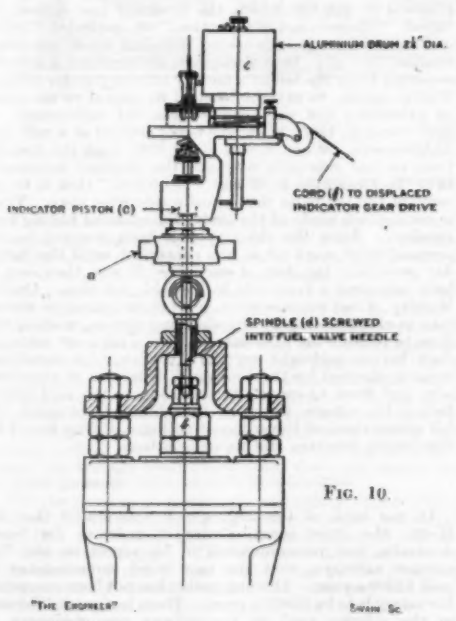

ALUMINIUM DRUM 2½" DIA.
CORD (f) TO DISPLACED INDICATOR GEAR DRIVE
INDICATOR PISTON (c)
SPINDLE (d) SCREWED INTO FUEL VALVE NEEDLE
"THE ENGINEER"
SWAIN Sc.

FIG. 10.

TABLE III.—*Digit Engine. Mean Results of Trials with 100° Fuel Cam Toe-piece and Six 9/64in. Holes in Sprayer Cap—see Figs. 5 and 16.*

R.P.M.	I.H.P.	B.H.P.	Mean indicated pressure.	Mechanical efficiency.	Maximum pressure.	Compression pressure.	Timing degrees B.T.C.	Blast pressure.	Fuel. lb./I.H.P. hour.	Fuel. lb./B.H.P. hour.	Exhaust temperature.
			lb./sq. in.	Per cent.	lb./sq. in.	lb./sq. in.	Actual.	lb./sq. in.			°F.
392	392.5	342	126.2	87.2	630	495	24	930	0.327	0.376	764
395	392	344.5	125.1	87.9	630	495	24	930	0.328	0.373	766
389	409	350	132.6	85.5	630	495	22	930	0.322	0.376	790
394	410	355	131.0	86.5	630	495	22	920	0.328	0.379	823
392	419	357	132.0	87.0	630	495	22	945	0.333	0.382	832
392.5	443	377	142	85.9	630	495	22	990	0.332	0.386	878
354	295	255	105	85.5	630	495	23	800	0.315	0.368	631*
312	211	166	85.2	78.6	630	490	25	750	0.310	0.395	458*
254	116	84.6	57.6	72.9	570	480	20	640	0.301	0.413	295*

* Trials at reduced powers. Approximate law: Power ∝ (speed)³.
Texas oil used. Exhaust was clear during all trials. No corrections have been made for power required by separately driven injection air compressor.

Some of the particulars of the test referred to are given on Figs. 7, 8 and 9, and additional extracts from the test sheets are as follows:—

Fuel consumption per I.H.P. hour = 0.304 lb. (including for motor-driven compressors).
Fuel consumption per B.H.P. hour = 0.431 lb. (including for motor-driven compressors).
Colour of exhaust = shaded.
Fuel nozzle six ¼in. holes (countersunk internally) on 120 deg. included angle.
Brand of fuel, Texas S.G. 0.079.
Running of engine satisfactory and uniform.
No detonation.

It will be observed that, in the above comparatively "low speed-high mean pressure" tests, no detonation occurred and also that the total fuel valve lift period was only 58 deg. of crank shaft travel. On speeding up the engine to 390 revolutions per minute detonation prevented a higher mean pressure than 120 lb. being employed when using the nozzle and fuel valve lift indicated in Figs. 2 and 7 respectively. Retaining the fuel cam of Fig. 7, various changes were made in the sizes of the holes in the sprayer nozzle, but this did not provide any sensible improvement. It was then concluded that the time available during the 58 deg. period of valve lift, *i.e.*, 0.025 sec., was too short for the normal combustion of the heavier fuel charges corresponding to the higher speed of revolution. In other words, that the injection of the fuel was too sudden and resulted in violent and erratic combustion. Typical cards, taken about this time, in which the effect of detonation is clearly shown, are given in Figs. 11, 12 and 13, the corresponding mean pressure being about 127 lb.

It was then decided to increase the valve lift period by fitting wider angle fuel cams. Several of the latter, giving longer periods, were tried in combination with various sprayer nozzles. The test results with these fuel cams showed some improvement, so far as detonation was concerned, upon those obtaining with the 58 deg. period cam, but generally left much to be desired. Experimenting in the direction of "increased fuel period" was, however, continued, and particular reference may be made to a special type fuel cam form which was amongst those tested and which gave promising results.

The valve lift diagram taken with this cam is shown in Fig. 14. It will be observed that the cam is of the double lift variety. The idea underlying this design is to inject the fuel in two stages, the first stage involving only the smaller portion of the fuel charge which, becoming ignited on injection, would create a high temperature zone for the reception and combustion of the following main fuel charge. A combustion diagram taken during a test with the "double lift" cam in operation is given in Fig. 15. There was no detonation during this test; but the increased noise attending the mechanical operation of this double cam was an unfavourable feature. Other particulars from this test are:—

Mean pressure	130 lb. per square inch
Brake horse-power ..	333
Fuel consumption	0.493 lb. per B.H.P. (including for compressor)
Exhaust	Clear
Fuel nozzle	Six ¼in. holes on 120 deg. angle

The ultimate solution of the detonation problem with

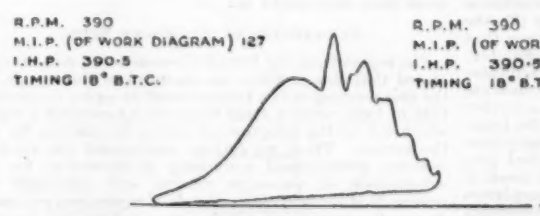


FIG. 11.

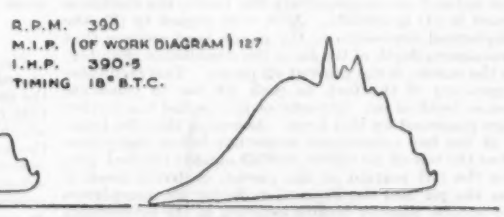


FIG. 12.

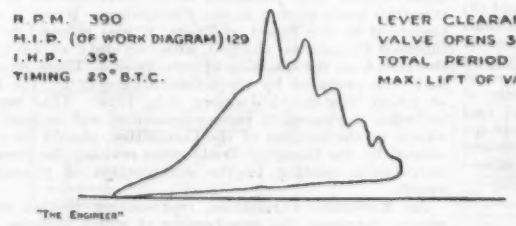


FIG. 13.

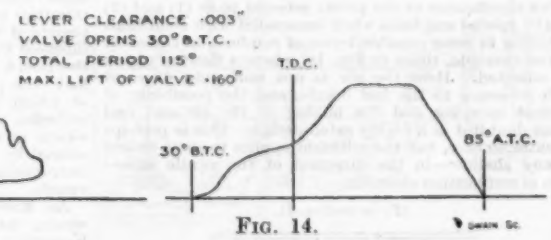


FIG. 14.

* Read at the spring meetings of the sixty-fifth session of the Institution of Naval Architects, April 11th, 1924.

heavy fuel charges at high speeds was found in a long-period fuel cam giving a comparatively gradual opening and closing of valve. The valve lift diagram taken with this cam is given in Fig. 16. It will be noticed that the total fuel period is 100 deg. of crank travel, representing at 390 revolutions per minute a period of 0.042 sec. Fig. 17 shows a typical combustion card, and Fig. 6 an ordinary indicator diagram taken with this cam in operation. The sprayer nozzle ultimately used, in combination with the above fuel cam, and which gave the best results with the heavy fuel charges, has already been referred to and is shown in Fig. 5.

The general particulars of a test with the latter combination of fuel cam and sprayer nozzle are :—

Revolutions per minute	392.5
Mean pressure	142 lb. per square inch
Brake horse-power	377
Indicated horse-power	443
Fuel per indicated horse-power hour	0.332 lb.
Exhaust	Clear

No difficulty was found in obtaining this power and the engine ran steadily. The foregoing brief notice of some of the experiments with fuel cams and sprayer nozzles will serve to indicate how vital is their influence on the output and behaviour of the engine generally. Typical results from a series of trials carried out on the engine with the long-period cam are shown in Table III.

3. Shaping of Combustion Chamber.

The problem of obtaining the best combustion chamber form for the reception of the injected fuel was one of the first to be faced. The essential features of such a combustion chamber appeared to be :—(1) It should group the maximum amount of air for combustion immediately round the sprayer nozzle. (2) The wall of the chamber opposite the sprayer should be the same distance at all points, from the centre of the fuel nozzle, in order to facilitate the directing of the jets so as to secure complete diffusion of the fuel throughout the combustion space. These considerations naturally led to the adoption of a hemispherical depression in the piston head to serve as a combustion chamber—see Fig. 4—the centre of the hemisphere being arranged at the centre of the sprayer nozzle. It is considered that the favourable grouping of the air around the fuel nozzle has contributed in no small measure to the attainment of the high mean pressures recorded in the Digit engine.

It will be appreciated that, with a combustion chamber shaped as shown in Fig. 4, and the linear clearance of the piston reduced to comparatively fine limits, the condition outlined in (1) is fulfilled. Also, with regard to (2), the hemispherical depression in the piston head ensures that the maximum depth of the air in the combustion chamber, from the nozzle, is the same at all points. This facilitates the spraying of the fuel, as each jet has to penetrate the same depth of air. Importance is attached to a further feature possessed by this form. Assuming that the injection of the fuel commences somewhat before the piston reaches the top of its stroke, the air outside the fuel jets, above the flat portion of the piston, is driven inwards across the jet into the depression during the completion of the stroke, thereby greatly assisting in the intermixing of the fuel and air. Additional impetus is given to turbulence of the air charge on the return stroke by the reversal of these air currents.

The significance of the points referred to in (1) and (2) receive special emphasis when contrasted with conditions obtaining in some possible forms of combustion chamber, as, for example, those in Fig. 18, where a flat-top piston is indicated. Here the air is not uniformly disposed with reference to the fuel nozzle, and the possibility of efficient spraying and the mixing of the air and fuel seems doubtful in a highly rated design. This is perhaps an extreme case, but the criticism applies to some extent to any shallow—in the direction of the nozzle axis—form of combustion chamber.

(To be continued).

The Railways Bill of the Irish Free State Government is meeting with considerable opposition from business and railway interests. Because the Great Northern has property in both the Free State and the Northern area it is left out of the proposals. But as it is the most prosperous of the railways its exclusion, together with the Northern Counties, and the Belfast and County Down, will, it is claimed, tend to stereotype the existing partition of Ireland.

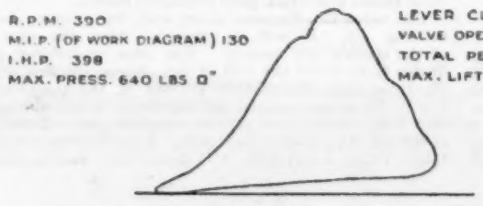


Fig. 15.

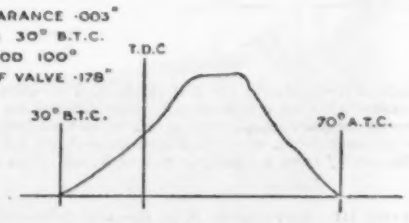


Fig. 16.

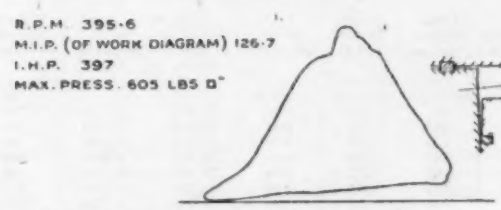


Fig. 17.

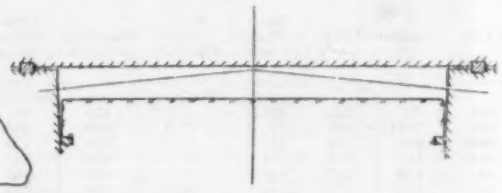


Fig. 18.

International Shipping Conference.

No. I.

Technical as well as commercial aspects of the problems which confront shipowners were included in the agenda of the International Conference which has been held this week at Leathersellers' Hall, London, and which terminates to-day. Delegates of all the principal maritime nations, including Great Britain, Germany, France, United States, Italy, Norway, Sweden, Denmark and Japan, have been present, and a series of discussions, some public and others private, have been held under the chairmanship of Sir Alan Anderson, President of the Chamber of Shipping. Delegates have been given an opportunity of making an inspection of the Port of London, and a well-arranged social programme has included a dinner at Fishmongers' Hall and a luncheon given by the management of Lloyd's Register of Shipping. The British Empire Exhibition is being visited to-day.

Sir Alan Anderson, in his opening address, said that reports would be presented from sub-committees appointed at the last Conference three years ago. An important group of reports, dealing with sub-division, load line, deck cargo, boats and wireless telegraphy, were bound up with the safety of life at sea, and all these reports were unanimous. He hoped to obtain unanimity for the statement that the unsinkable ship was a myth, and a dangerous myth, if it induced false confidence. The one absolute safeguard at sea was a vigilant master, but bulkheads and the other precautions might mitigate disaster and were more likely to prove useful if the regulations which govern them were wisely framed. On sub-division, one of the most technical of this range of technical subjects, one nation—France—took a different view from the others on the criterion of service. The difference, which appeared to be due to local conditions in a trade in which the one dissenting nation was especially concerned, was fully debated in an international committee, and found to be incapable of adjustment. The report on sub-division, therefore, represented the unanimous opinion of all the nations except one. Delegates would be invited to adopt these reports, to pass resolutions for further action, and to decide whether the Conference should press the Governments in all countries represented to call an International Diplomatic Conference on all or part of the rules for "safety of life at sea." It was evident from all these reports that shipowners of all nations thought that the existing rules were at once less efficient and more burdensome than they might be.

Sub-division of Passenger Ships.

The report from the British Committee on Sub-division stated that this problem was included in the agenda for the first meeting of the International Shipping Conference held in 1921, when a Joint Committee presented a report which led to the adoption of certain resolutions by the Conference. These resolutions emphasised the need of securing international uniformity in regulations for the sub-division of passenger vessels, and expressed the opinion that the international code of regulations contained in the Convention of London was incomplete, unsatisfactory and required immediate revision. An International Committee was again appointed, and its report has, the report states, been presented to the Governments of the countries participating in the Conference. When it was presented to the Board of Trade, it was referred to an informal Committee charged with the duty of advising the Board on the question of sub-division. Three reports had been prepared by the informal Committee, the last of which was dated January 7th, 1924. This report embodies the complete recommendations and suggestions which, in the opinion of the Committee, should be considered by the Board of Trade when revising the present instructions relating to the construction of passenger vessels.

An Executive Committee, representing British shipowning interests, the membership of which includes Sir Kenneth S. Anderson, Sir Westcott Abell, Mr. G. W. Barr, Mr. A. C. F. Henderson, and of which the late Mr. L. Peskett was also a member, has had an opportunity of examining this report, and has made various representations to the Board of Trade on the subject. The present position of the campaign to amend the rules governing sub-division in Great Britain is set out in the report of the British Committee.

The German report on sub-division states that statutory provisions for water-tight bulkheads on passenger steamers carrying more than fifty passengers, on extra-European voyages, have been in force in Germany since 1896. These provisions have always been carried out very strictly by the survey authorities, *i.e.*, the See-Berufsgencossenschaft, so that German shipowners have been accustomed for more than twenty-five years to fit their passenger steamers with water-tight bulkheads, in accordance with these provisions. The effect of these provisions is a decrease in the draught of these ships. In spite of this, however, German passenger steamers have reached a high state of perfection within recent decades. German shipowners are therefore unable to make use of this Conference, which, after all, was convened as a direct result of the Titanic disaster, for the purpose of diminishing the degree of security of their passenger vessels which has hitherto been customary and statutory in Germany. They must rather submit that the degree of safety provided in German bulkhead requirements should be retained and introduced universally.

French delegates point out that they are not in agreement, among other provisions, with the British formula on the "criterion of service" drawn up subsequently, either from the scientific point of view or from the point of view of the result of its practical application. Under this last head, vessels of the mixed type are, it is stated, treated more severely by the application of this formula than are vessels of the purely passenger type.

The Conference passed a resolution asking that a Diplomatic Conference on the subject of safety of life at sea should be convened.

SIXTY YEARS AGO.

In the course of a leading article entitled "Fuel," in our issue of May 13th, 1864, we discussed the possibilities of petroleum, peat and producer gas, as substitutes for coal or coke. Against the use of petroleum, the chief objection urged was its high cost—it was then quoted at nearly £10 a ton in New York and £20 at Liverpool—but we remarked that the expense of transporting it from the wells to the consumer was a very considerable item in its total cost, and might yet be effected at a greatly diminished rate. The pipe line and the oil tanker have since that date revolutionised the transport of petroleum, and to them, although it may not always nowadays be remembered, we owe almost entirely the present development in the use of oil fuel. It was added that another difficulty in the way of the employment of petroleum as fuel lay in the fact that we did not possess safe and efficient mechanical means for its combustion. Its storage and its graduated admission to the furnace presented problems which had still to be solved. We suggested that the best method of burning it might be to spray it over a surface of incandescent coke or fire-brick "in trickling streams as from the rose of a watering pot." Against the use of peat the principal objections then, as now, were the large amount of water which it contained in its natural state, and the expense involved in bringing it to a useful form. Its great advantage was its freedom from sulphur, but we anticipated that its cost would always be a bar to its employment as a competitor with coal. On the subject of producer gas we expressed a very favourable opinion. Basing our views on the success that had attended Mr. (Sir William) Siemen's regenerative gas furnaces and producers, we drew attention to the economy, the ease of control, the absence of smoke and the facility for the removal of sulphur which the producer gas system entailed. "There is not an invention," we concluded, "which at the same stage of working promises more important results." . . . In a paragraph we recorded a disaster resulting from the fall of a factory chimney under circumstances which, to say the least of it, appeal to us to-day as exhibiting not only carelessness but callousness. A new chimney, 150ft. high, was being erected at a mill near Saddleworth. When it was about 60ft. high the foundations on one side gave way and the chimney acquired a tilt. To straighten it, it was "stretched," that is to say some of the joints on the opposite side were sawn. There is no mention made of the faulty foundations having been repaired. After the chimney had been restored to the perpendicular, work on it was continued, until the Saturday preceding the date of our issue It was then seen to have acquired a fresh tilt in the old direction. On the Monday, it had become worse, but beyond placing a watchman in charge to report any alarming change, nothing was done to remove the inhabitants of some adjacent cottages. Just before midnight on the Tuesday, the watchman became alarmed by the continued deflection of the chimney, and went to report its condition to the mill owner. Before his return, however, the chimney collapsed. It fell across three of the adjacent cottages, killing ten of the slumbering inmates and injuring others.

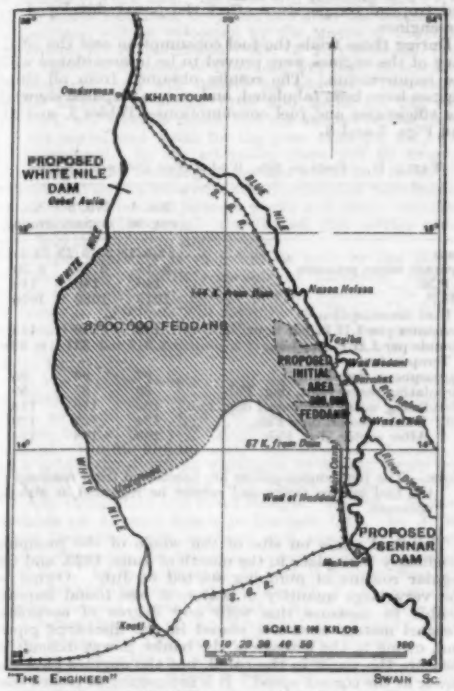
In our issue of the 25th ult. it was stated that Mr. Webb, the chief commissioner of railways for South Australia, had recommended, in his report on the Tasmanian railways, that the new chief commissioner be paid £2500 a year. This suggestion has not been accepted; the salary is to be £2000 a year. There is a great difference in the salaries paid to the railway commissioners in Australia. Whilst Victoria pays £5000, New South Wales only gives £3000. The explanation is probably that an American railwayman holds the former appointment.

As from January 1st last, in view of the increased cost of living, the wages of the men included in the conciliation scheme have been increased, but men of the salaried staff have had no corresponding advance. The railway companies' argument is that, in the case of the salaried staff the bonus was given to relieve "hardship" cases, and was intended to disappear gradually with the fall in the cost of living, but not to rise if the cost went up, unless it reached 125 points above the pre-war datum, which was the point, it was contended, fixed by the agreement. The railway unions argue to the contrary, and the question recently came before the Central Wages Board. Agreement not being arrived at there, the matter should have gone to the National Wages Board, but the parties agreed to refer it to the arbitration of Sir William Mackenzie, the chairman of the latter Board.

Irrigation Pumping Machinery (Gezira Scheme), Sudan.*

By RICHARD W. ALLEN, C.B.E., Vice-president.

THE object of the Gezira (or island) irrigation scheme is to provide, for the purpose of growing cotton, the irrigation of the northern portion of the Gezira plain, which



NOTE.—A Feddan is approximately an acre.

FIG. 1—PLAN SHOWING GEZIRA IRRIGATION SCHEME

may be roughly described as the triangular tract of country lying between the Blue and the White Niles in the Sudan, south of Khartoum—see Fig. 1. The large and immediate increase of the cotton-growing area is now assured, and during the next few years it will be possible to bring under cultivation an area of nearly half a million acres in the Blue Nile and Kassala areas.

The Gezira irrigation scheme is very clearly described by Sir Murdoch Macdonald in his report to the Ministry of Public Works, Egypt, entitled "Nile Control," published in 1920. It was in the year 1899 that Sir William Garstin, who was the Adviser to the Egyptian Ministry of Public Works, first recognised that the great Gezira plain might be irrigated if a barrage were constructed on the Blue Nile at Sennar, to hold up 7 m. or 8 m., whereby the level of the Blue Nile could be maintained at flood level at any season, and so feed a canal taking out of the Blue Nile above the barrage from which point the canal would run to Wad Medani.

For the purpose of testing the suitability of the Gezira soil, an experimental pumping station was erected in the year 1911 at Tayiba, which is situated about 11 kiloms. north of Wad Medani. The results of this station were most successful, and it was decided that further pumping stations should be installed, and not wait until the completion of the dam for the development of the scheme.

A second pumping station was erected in 1914 at Barakat, a short distance south of Wad Medani, and a third in 1921 at Hag Abdalla, south of Barakat. The fourth, and largest of all, the subject of this paper, was completed in June, 1923, at Wad-el-Nau, which is situated between Hag Abdalla and Barakat.

Irrigation by means of these four pumping stations is generally carried on during nine months of the year, from about July 15th to April 15th, and owing to the high atmospheric temperature of the day, all pumping is done at night between the hours of 9 p.m. and 9 a.m. The whole Gezira irrigation scheme, as outlined by Sir Murdoch Macdonald, is now being completed, and is a stupendous engineering undertaking.

The dam is actually at Makwar, a few miles south of Sennar, and is in course of construction. It is 2 miles in length, and when completed in 1926, will be one of the greatest engineering constructions of its kind in the world. The main irrigation canal leading from the Makwar Dam to that part of the plain to be irrigated, and the smaller irrigating canals, are nearly completed. A portion of the canal system is now in use conveying water from the four pumping stations.

WAD-EL-NAU PUMPING STATION.

In the early part of the year 1922 a start was made on the erection of the Wad-el-Nau station, situated about 180ft. from the river bank on the west side of the Blue Nile. The engine house is 194ft. long by 31ft. wide. A plan is given in Fig. 2. It was determined that the quantity of water required from this station should be approximately 52,000 gallons per minute. Owing to the distance of Wad-el-Nau from the main irrigation canal, which flows from the dam at Makwar to Wad Medani, it was necessary to construct a feeder canal, and it was decided that the water should be pumped from the station to the feeder canal through a rising main nearly half mile long. This determined the head, namely, 83.6ft., against which the pumps had to work. It was further decided that, owing to the difficulty of obtaining coal or wood for fuel, Diesel oil engines should be installed for driving the pumps, and that they should be three in number, each pump to be capable of delivering 26,000 gallons of water per minute, two working together and one set as spare.

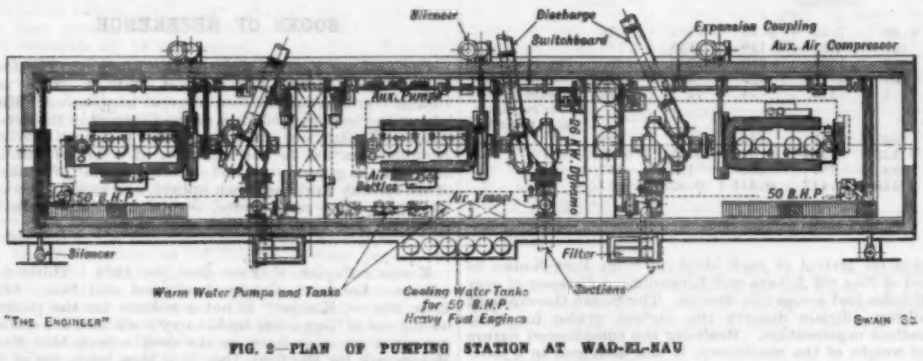


FIG. 2—PLAN OF PUMPING STATION AT WAD-EL-NAU

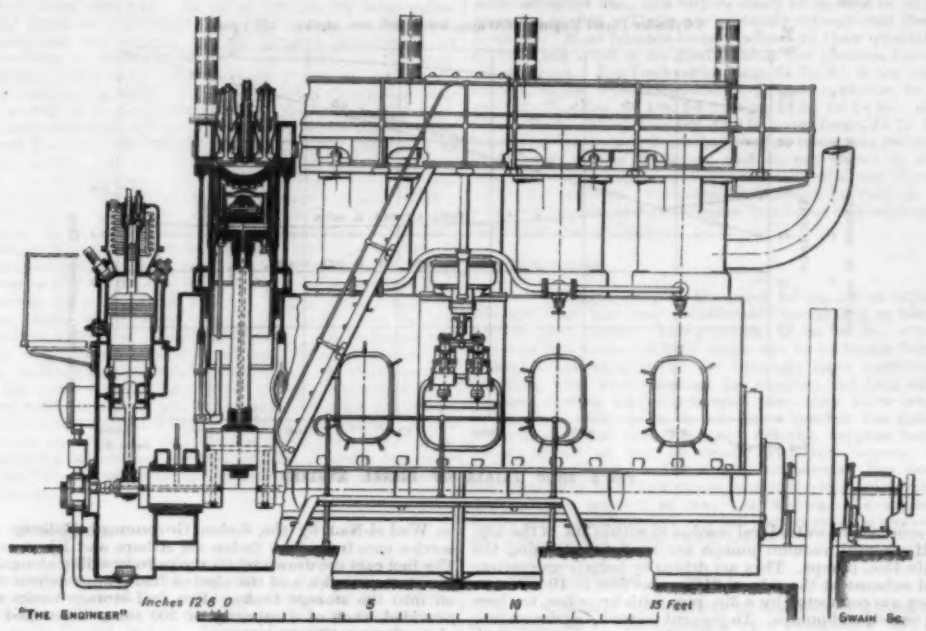


FIG. 3—850 H.P. DIESEL ENGINE

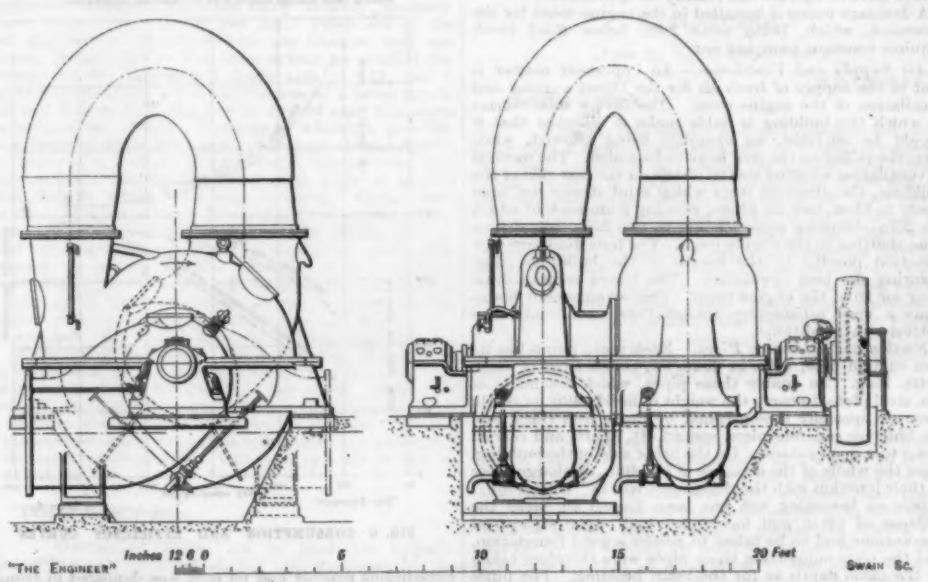


FIG. 4—MAIN PUMP—WAD-EL-NAU PUMPING STATION

MAIN PUMPING MACHINERY.

The main pumping machinery consists of three four-stroke vertical Diesel engines—see Fig. 3—each capable of giving off 950 brake horse-power at 150 revolutions per minute.‡ They are coupled direct to the main centrifugal pumps, which are of special design—Fig. 4. Each pump has two casings bolted together and joined in series by means of a steel connecting pipe, while the two similar impellers are carried on one shaft. The duty of each pump is to deliver 2 cubic metres per second (or 26,000 gallons per minute) against a maximum total head of 83.0ft., this head being based on the assumption that the water level in the river does not fall below 1279ft. above sea level—at Alexandria—and that in the delivery canal does not rise to more than 1349ft. above the same. Two of the main centrifugal pumps normally deliver together into the canal, the third set being a standby.

The auxiliary machinery of the station consists of two 50 horse-power hot-bulb engines, driving, by means of friction clutches, 187ft. of shafting fitted with ball bearings and expansion couplings. These 50 horse-power engines are only used for starting purposes, after which the shafting is driven by the main engines. They are again used on shutting down, to maintain the circulation of the cooling water for the Diesel engines for a time. The shafting is used for driving the vacuum pumps, make-up pumps, the dynamos and an air compressor for the initial charging of the air bottles. This auxiliary compressor has an approximate capacity of 11 cubic feet of free air per minute at a pressure of 1000 lb. per square foot. Other auxiliaries, which are motor driven, include three cold and three warm water pumps for circulating.

For the removal of silt from the cooling water, a concrete settling tank was built near the junction of the three 40in. discharge pipes, and is fed by a 6in. branch from the same. After passing through the tank, alternately over and under a series of partitions, the water gravitates to steel tanks in the pumping station, which, in turn, supply the cooling water pumps. The visible

* Institution of Mechanical Engineers, May 9th, 1924.—Abridged.

‡ The engine is of the Burmeister and Wain land type.—ED. THE E.

outlets consist of funnels mounted on the top platforms of the main Diesel engines, and after passing through these the water gravitates to tanks in the basement, which, to ensure that the pumps always remain fully charged, are maintained at constant level by means of a reflux valve fitted on the outlet side. These tanks are discharged by the warm water pumps to the river, and to prevent them overflowing and flooding the basement, a float chamber with electric alarm gear is installed, whereby a bell is rung as soon as the water level reaches to within 3in. of the top.

Horizontal vacuum pumps are used for charging the main 45in. pumps. They are driven by belts from shafting and exhaust at the rate of 2100 cubic feet in 10 minutes. They are connected by a 3in. pipe with branches, to three air vessels and pumps. To prevent water being drawn into the vacuum pumps and causing damage, a charging tank fitted with a ball valve is installed; while, to help to check any sudden rush of water, perforated diaphragms are also inserted in each of the three branches leading to this tank. Should water enter this, the ball valve closes and the water is prevented from getting beyond this tank. In this case the system has to be drained.

As an additional safeguard against the ball valve not working, a barometric pipe, rising to a height of nearly 40ft. above supposed high water level, was fitted above the charging tank. As the Nile rises some 40ft. during the wet season, the varying conditions under which the vacuum pumps have to operate can readily be appreciated.

A drainage pump is installed in the engine-room for the basement, which, being some 30ft. below flood level, requires constant pumping out.

Air Supply and Ventilation.—An important matter is that of the supply of fresh air for the Diesel engines and ventilation of the engine-room. The severe sand storms to which the building is liable make it essential that it should be air-tight, no openings being allowed, while even the ridges on the roof have to be sealed. The method of ventilation adopted was to install on the east side of the building, the direction from which sand storms are least likely to blow, two air filters, running from each of which are 25in. diameter pipes leading to two fans, belt driven from shafting in the engine-room. The fans discharge in a direction parallel to the length of the buildings, thus ensuring the best circulation. The Diesel engines draw their air from the engine-room. This arrangement maintains a very satisfactory temperature, even under the hottest sun conditions.

Suction and Discharge Pipes.—Each main pump has its own suction pipe, 40in. in diameter, constructed of steel, 184ft. long. To enable these pipes, which are made of ⅜in. steel plate, to carry the weight of nearly 40ft. of earth, they are specially strengthened by angle iron rings, and are built on concrete piers, spaced 6ft. apart, and carried down to a good subsoil. On the other side of the building, since the whole of the distance of the 40in. discharge pipes to their junction with the rising main was in "cotton soil," which on becoming wet has been known to cause the collapse of plant and machinery built upon it, special precautions had to be taken to ensure a good foundation, and the piers supporting these pipes were therefore taken to the same depth as for the main building. The pipes are of steel, ⅜in. thick and 115ft. long. A problem here encountered was to connect the three 40in. discharge pipes, which converge and rise at an angle of approximately 4 deg., to the three-way piece which unite them with the 72in. rising main. Here the pipes are securely fixed at one end of the wall of the building and expansion pipes are fitted, the supporting piers being so constructed as to allow of free movement. To ensure that these pipes came into line, the flanges of the 40in. bend above the butterfly valve over the pump were left loose, and, after being set at the correct angle, were drilled and riveted on site, a closing length being left on each section and cut to suit. The rising main is about 2130ft. long, and connects to the delivery or feeder canal. It is fitted with a 24in. vent pipe to a height of 30ft. above the three-way piece.

Oil Fuel Supply and Storage Tanks.—Fuel oil is brought to Wad-el-Nau by the Sudan Government Railway oil service cars from Port Sudan *vid* Atbara and Khartoum. The fuel cars are drawn up on the railway siding alongside the storage tanks, and the electric fuel pumps deliver the oil into the storage tanks. Two fuel storage tanks are provided, each of a capacity of 300 tons, dispatched in plates for erection on site.

Delivery of Machinery to Site.—The whole of the machinery was shipped to Port Sudan and conveyed by special trains on arrival of each shipload from Port Sudan to Wad-el-Nau *vid* Atbara and Khartoum, a distance of over 700 miles and across two deserts. The Sudan Government Railway officials deserve the highest praise for their excellent organisation. Realising the complicated nature and weight of the machinery, it was delivered in a most expeditious manner and no part was damaged in transit. To deal with about 1000 tons of machinery delivered in the wilds, some preparation was required, and for this purpose a special single-track railway, 6 miles long, had to be constructed from the Sudan Government Railway at Wad-el-Nau railway station to the pumping station, from sidings at which the machinery was unloaded by means of a 10-ton steam crane. The railway siding, being 10ft. higher than the entrance to the pumping station, a slipway was constructed between the two, down which all the plant was lowered on rollers to the entrance. Here it was handled by two 15-ton travelling cranes, and lowered an additional 26ft. on to the floor of the pumping station.

Trials of Machinery.—Both the main engines and all the auxiliary machinery were subjected to exhaustive trials before shipment, the results obtained from these trials proving that each of the main engines had an ample margin of power to meet all requirements under actual working conditions, where both the considerable altitude and tropical temperature affect the power developed by the engines.

During these trials the fuel consumption and the efficiency of the engines were proved to be in accordance with the requirements. The results obtained from all three engines have been tabulated, and curves prepared showing the efficiencies and fuel consumptions—Tables I. and II. and Figs. 5 and 6.

4-Cylinder Diesel Engine. 630 mm. bore, 850 mm. stroke. 150 r.p.m.

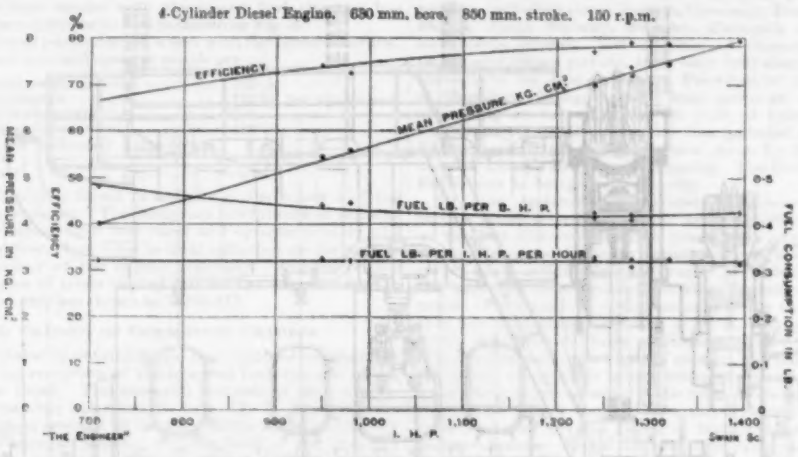


FIG. 5—SHOP TRIALS OF DIESEL ENGINES

TABLE I.—*Diesel Engine Test Sheet: Shop Trials: Wad-el-Nau Pumping Station.*

	No. 1 engine.		No. 2 engine.				No. 3 engine—4-cylinder.			Remarks.
Date	22/9/22.		19/10/22.		20/10/22.		20/11/22.			
Proportion at full load	Full	10% overload	¾	¾	Full	10% overload	¾	Full	10% overload	
Average mean pressure, indicated kg./cm.²	7.25	7.91	4.03	5.51	6.98	7.42	5.42	7.02	7.39	
R.P.M.	150	150	150	151	151	151	149	150	147	
I.H.P.	1280	1395	710	980	1240	1320	950	1240	1280	Figures given are average values taken over considerable periods.
B.H.P.	945	1035	472	710	956	1040	702	980	1010	
Mechanical efficiency, %	73.8	74.2	66.6	72.5	77.1	78.6	74	77.2	79	
Fuel oil consumption—										
Grammes per I.H.P. per hour	141	142	145	145	146	147	148	130	148	
Pounds per I.H.P. per hour	0.311	0.313	0.320	0.320	0.322	0.324	0.326	0.331	0.326	
Grammes per B.H.P. per hr.	191	192	218	201	188	187	200	194	187	
Pounds per B.H.P. per hour	0.421	0.424	0.480	0.443	0.414	0.412	0.441	0.428	0.412	

4-Cylinder Diesel Engine. 630 mm. bore. 850 mm. stroke. 150 r.p.m.
Anglo-Persian Fuel Oil. Specific Gravity 0·89 at 60° F.
Heating Value (average sample) B.Th.U., 17,600 net, 18,575 gross.

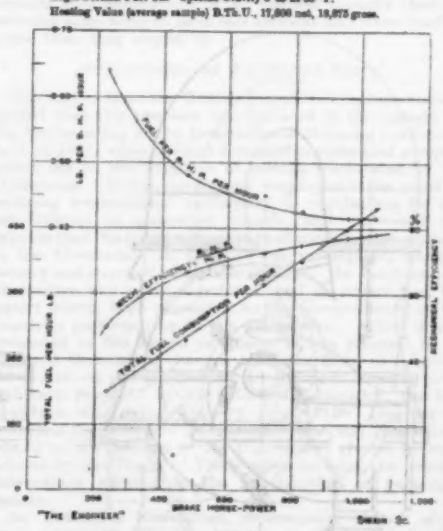


FIG. 6—CONSUMPTION AND EFFICIENCY CURVES

TABLE II.—*Tests on Site, Wad-el-Nau Pumping Station.*

	No. 1 engine.	No. 2 engine.	No. 3 engine.
Date	22/5/23	23/5/23	23/5/23
Average mean pressure	6.14	6.55	6.20
R.P.M.	140	140	140
I.H.P.	1015	1080	1025
Fuel consumption—			
Grammes per I.H.P. per hour	144	146	145
Pounds per I.H.P. per hour	0.317	0.321	0.320
Temperatures—			
Atmosphere, deg. Fah.	97	96	95
Circulating water inlet, deg. Fah.	89	87	90
Circulating water discharge, deg. Fah.	122	116	118
Oil: Before cooler, deg. Fah.	134	128	129
After cooler, deg. Fah.	109	108	111

NOTE.—The fuel consumptions are calculated from readings of the fuel service tanks and cannot be regarded as strictly accurate.

The final trials on site of the whole of the pumping machinery took place in the month of June, 1923, and the regular routine of pumping started in July. Owing to the very large quantity of water, it was found impracticable to measure this with any degree of accuracy. Venturi meters were not placed in the discharge pipes, and, owing to the leakage of the banks, it was difficult to measure the water in the canal, but the engines gave the power at the correct speed. It is interesting to record that the conditions on site are as follows:—The altitude was 1300ft. above sea level, but barometric readings were not recorded; the air temperature during the official trials on site was 97 deg. Fah.; and the temperature of the cooling water about 87 deg. to 90 deg. Fah.

BOOKS OF REFERENCE.

The Railway Year Book for 1923. London: The *Railway Magazine*, 33, Tothill-street, S.W. 1.—This new volume contains information of great importance. Much labour has been expended to revise thoroughly the details connected with our railways under grouping. Whilst grouping has led to the omission of a lot of familiar material, the general style and standard of the "Whitaker" of the railway world has been upheld, and looking through the volume we have found several new and valuable features. The book is published at 5s. net.

Kempe's Engineers' Year Book for 1924. Thirty-first edition. London: Crosby Lockwood and Son. 1924. Price 30s.—"Kempe" is not a volume for the pocket; no one out of Gargantua could carry it without discomfort, but since we must have on the desk a book that rivals Molesworth for the field, then it is that book, for of the many volumes of notes and memoranda, of formulæ, rules and tables for engineers there is not one so bursting with information as it. We recall it in its early days, when it was a slim book of no more than 570 pages; now it has waxed extremely portly, but it seems to have lost none of its youthfulness; indeed, under the hands of a long array of expert contributors it renews its youth annually, and its portliness must be justly regarded as due to muscularity and not to adiposity. Let us say at once that we have not been through every one of its 2868 pages. There may be errors in them, there are certain to be omissions from them. We do not care; what remains makes up for what is lost, and "Kempe" remains, as ever, the most essential reference book on our library shelves. It seems a work of supererogation to describe it, but since there may be some who have not made it their daily companion, let us say that, besides rules, formulæ and data, it contains a large amount of descriptive letterpress, so that it becomes a condensed encyclopædia of engineering. It is divided into convenient sections, and is well indexed.

ACCORDING to an official return of the Mines Department, the value of stores consumed by the mines of the Union of South Africa last year was £15,695,000, as compared with 13 millions in the strike year and about 17½ millions in 1921. The gold mines last year spent £13,425,200, the coal mines £1,211,100, diamond mines £722,300, and miscellaneous mines £336,150. The two latter categories reveal considerable increases compared with the previous year. By far the largest items in the costs of the mines were explosives, amounting to £1,543,000, and electric power and light purchased £1,521,400, besides £400,000 for compressed air. As a result of the new agreement between the Victoria Falls Power Company and the gold-mining companies, which supersedes that previously in force for the next seven years which the old contract had still to run, it is expected that the cost of power will be substantially reduced. In spite of the very general use of electric power the Rand still spends £970,000 a year on coal. Another very large item in the annual bill is £925,000 for timber of various descriptions.

The Institution of Municipal and County Engineers.

THE fifty-first annual general meeting and Conference of the Institution of Municipal and County Engineers will be held in London on Wednesday, Thursday, Friday and Saturday, June 25th to 28th next.

The following programme has been arranged:—On Wednesday, June 25th, members will assemble at 10 a.m. at the North End Hall, Croydon, and after the transaction of business, will be welcomed by the Mayor of Croydon, Alderman W. B. Southwell. Mr. G. F. Carter, M. Inst. C.E., borough engineer of Croydon, will then be installed as president, and will deliver his address. The award of the Richard Pickering Prize and Medal for the year 1923–24, will then be made, and the subject of the thesis for the medal and prize for the year 1924–25, &c., will be announced. In the afternoon there will be alternative visits to A, Beddington sewage works and farm, the Russell Hill service reservoir, and the Croydon Aerodrome; or B, South Norwood sewage works and farm—fertiliser manufacture (190 acres)—the Russell Hill service reservoir, and the Croydon Aerodrome.

On the Thursday a visit will be paid to the Metropolitan Water Board's reservoir at Littleton, now in course of construction, and to arterial roads in the West of London. Members will assemble at 10 a.m. at Westminster District Railway Station, Embankment entrance. At 7 p.m. the annual dinner of the Institution will be held at the Hotel Cecil.

On the Friday members will meet at the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, at 10.30 a.m., and will listen, first of all, to an address by Sir Henry P. Maybury, K.C.M.G., Director-General, Roads Department, Ministry of Transport, after which there will be discussion of papers which will be taken as read. Then will follow a discussion on "Traffic Congestion and Road Bridges," and on "Modern Methods on Ancient Roads in Durham City," by J. W. Green (member), city engineer and surveyor, Durham. In the afternoon the following papers will be discussed, "Oil Fuel," by R. H. Bicknell, M. Inst. C.E. (hon. member) and "Sewage Disposal," by J. Haworth, F.I.C., manager, sewage disposal works, Sheffield. At 7 p.m. there will be a ladies' festival of the Municipal and County Engineers' Lodge, No. 3920, at the Connaught Rooms.

On the Saturday a visit will be paid to the British Empire Exhibition, when a paper on "Concrete Construction in the Exhibition," will be read by Sir E. O. Williams, K.B.E., B.Sc., A. M. Inst. C.E., engineer to the Exhibition, and discussed.

AFRICAN DISTRICT MEETING.

An African District meeting of the Institution of Municipal and County Engineers is to be held at Pretoria from June 16th to 19th next. The following programme has been arranged:—On Monday, June 16th, members will assemble at 11 a.m. at the Town Hall, Pretoria, and will be officially welcomed by his Worship the Mayor. An address will then be delivered by the district chairman, Mr. H. M. Ladell, who is town and water engineer of Wynberg, after which a paper will be read and discussed. In the afternoon there will be visits to the Pretoria sewage disposal works, the power station and other municipal works.

On the Tuesday morning, starting at 10 a.m., further papers will be read and discussed, and in the afternoon there will be alternative visits to the Pretoria cement works, and to the Oliphantsfontein stoneware pipe works. On the Wednesday, at 10 a.m., a further paper will be read and discussed, after which the chairman and secretary for the ensuing session will be elected and general business transacted. In the afternoon a visit will be paid to the Bon Accord dam and quarry. On the Thursday the Hartebeestpoort dam is to be visited. The papers discussed will be presented by Mr. D. E. Lloyd Davies, city engineer of Cape Town; Mr. D. P. Howells, town engineer of Benoni; Mr. W. C. Storrar, city engineer of Pretoria; and Mr. J. A. Caskie, city engineer of Bloemfontein.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Unsettled Market Conditions.

CONDITIONS in the iron and steel market in this district are unsettled and business is slow. Many branches of trade in the Midlands are experiencing what is hoped may be only a temporary lull, while in the basic industries there is a slackening off, accompanied by an undercurrent feeling of insecurity. Iron and steel masters declare that while a certain amount of business is being done it is not large. New inquiries continue to be presented, but the note of persistency is lacking. Some fairly heavy contracts were made in various departments at the quarterly meeting, but specifications for delivery so far have not come up to expectations. Buyers of all classes of material appear to be fairly well stocked for present requirements. Several circumstances combine to dull the edge of business. Confidence has been shaken by the attitude of the Government regarding the McKenna duties. Whatever the outcome of the storm which has been raised, it has had the immediate effect of frightening off business which was developing on the strength of the headway made by the motor car industry. Negotiations for steel and other supplies have been broken off or have ended in modified commitments. At Coventry, where the number of unemployed has been reduced from over 9000 at the end of 1921 to less than 1000, the reverse process has already begun. The state of suspense as to fuel supplies likewise causes manufacturers to await developments before entering into further commitments.

British Industries Fair.

The British Industries Fair is being held at Castle Bromwich, near Birmingham, this week, and one cannot fail to be struck by the general spirit of confidence and optimism which prevails amongst manufacturers exhibiting there and their evident determination to triumph over adverse circumstances and to capture new markets, if that be at all possible, in place of those which have been lost. So far as exhibits by large industrial firms are concerned, the Fair appears to have lost something on account of the Empire Exhibition at Wembley, to which a number, particularly in the engineering group, have been naturally attracted. Although the engineering section is not as large as it was last year it is still of a comprehensive and important character. Among features worthy of attention are a new attachment for a vertical spindle moulder for the trenching of stair strings, and a small turret lathe primarily adapted for use for wireless work. Among other exhibits there is a portable coke-fired furnace for rivet heating, and a hack-saw so constructed that the user may immediately adjust it to suit a length of broken blade. Another exhibit of importance to engineers is that of a number of manufacturers, members of the Association of Drop Forgers and Stampers, who have a joint stand where samples of every kind of drop forged article may be seen, from the heaviest crank shaft and axles to the smallest blanks for pliers and scissors. The Birmingham Gas Department's stand is illustrative of the work of the Industrial Research Laboratories. It exhibits one of the latest types of gas furnaces of a regenerative type fired with the town's gas at ordinary pressures and fitted with a natural draught flow. A further exhibit is a 30-ton tension compression and torsion testing machine. The apparatus is designed for the testing of steel, concrete, or leather, and all forms of engineering and constructional material.

Steel Prices.

The steel market, generally speaking, is quiet. The increase of 2s. 6d. per ton in structural material reported last week has not been adopted by all makers, but some firms which are well booked up continue to quote £9 17s. 6d. to £10. Buyers, however, it is claimed, can easily find alternative and cheaper sources of supply. As a matter of fact, British joists and angles can be bought at something like 10s. under the nominal price of £10. A good deal of feeling exists in some departments of the steel trade as to the effect of the withdrawal of the McKenna duties. Instances are given of the breaking off of negotiations for large contracts for steel for use in the motor industry, and of a return to the system of buying over short periods. Some of these cases are verifiable. The wages crisis in the building trade and the uncertainty of its outcome tends to restrict business in the structural and some other departments. Certain of the Black Country rolling mills seem to have been rather better employed since the Easter holiday, but business remains far from brisk. Though late prices are maintained their stability cannot be answered for. For billets, makers who were lately quoting £8 15s. are now accepting a little over £8. Competition from Belgium and other continental countries is said to be reviving, but the recent increase in deliveries is chiefly on account of standing contracts. Prices of Belgian billets are scarcely competitive with the English quotations, when cash terms and other sales conditions are considered, and very few orders are being placed abroad.

Scrap.

Weakness prevails in the scrap department, and both iron and steel scrap values are down. A good deal of wrought iron scrap is coming on the market, and the price has been reduced by about 5s. per ton.

Staffordshire Bar Iron.

Finished iron is one of the soundest departments of the market at the moment, and makers of Staffordshire marked bars are fairly steadily occupied. Prices remain firm at £15 per ton. Producers of the best qualities of unmarked bars are likewise well employed, though not to the same extent as marked bar houses. Crown bars find a ready sale at £13, and it would be difficult to negotiate business at a lower figure. Nut and bolt and fencing iron is slow of sale, but prices are maintained at £12. Consumers, wherever possible, have been for some time past holding up their orders in the hope of a revival of continental competition, and their attitude has been stiffened this week as several fresh Belgian offers have been received. These offers are some 5s. per ton lower than recent continental quotations, and, as I pointed out last week, delays in shipment are now being overtaken, so that there seems some prospect of getting supplies through in a reasonable time. Staffordshire ironmasters accordingly express some anxiety as to the development of the situation, fearing another raid by foreign producers of No. 3 iron on the nut and bolt trade of this district. A slight improvement in shipbuilding has taken place, and the demands of the chain and anchor makers should tend to strengthen the position of the Staffordshire bar trade. Makers of wrought iron gas tube strip report a little improvement in business and continue fairly well employed. In view of the increasing activity of the tube mills they are hoping to do much better shortly. Values remain firm at £13 5s. to £13 7s. 6d.

Falling Sheet Values.

Galvanised sheets are in moderate request. Competition is intensified among manufacturers by the starting of an additional mill, and in order to secure much-needed business, some makers have reduced their price by 5s. per ton. On 'Change in Birmingham to-day—Thursday—quotations ranged from £17 to £17 5s. Some business was reported to have passed at £16 17s. 6d. The steadiness of the black sheet trade is unaffected. There has been a slight renewal of interest in tin-plates, small orders having been taken at 24s. per ton f.o.t.

Raw Iron Values Weaker.

In pig iron business continues dull. A little more activity is observable in foundry iron, chiefly on account of increased employment for foundries producing rain-water goods, grates and stoves, and other light castings. Though the average of prices for all grades of pig iron remains unaltered, some producers of No. 3 Derbyshire foundry pig who are under pressure to sell have this week accepted 94s., and buyers claim to be able to strike bargains at 93s. These are certainly exceptional deals, however. Most furnace owners adhere to their quotation of 95s., but there is no doubt about the position having deteriorated. For Derbyshire forge £4 7s. 6d. is the price named, while Northamptonshire brands continue to be quoted: foundry, £4 12s. 6d.; forge, £4 5s. to £4 6s.; and North Staffordshire foundry, £4 15s.; and forge, £4 7s. 6d. per ton at furnaces. There has been no restarting recently of furnaces in the Midlands, and no movement in this direction can be expected unless the coke situation should decidedly improve. Considerable anxiety prevails as to what will happen in this direction, but hopes of a reduction in coke prices run high.

Fuel Values.

Owing mainly to the great falling off in export demand there has been considerable weakening in blast-furnace coke prices. The premium of 3s. to 5s., which smelters had to pay a little while ago is no longer being enforced, and supplies to the furnaces have improved. Smelters, who were pleading for supplies not long ago, are now getting bigger deliveries than they know what to do with. The price on the open market has fallen lower than it has been for many months, supplies being freely offered at 24s. at ovens, with few buyers. A conference of coke makers and furnacemen has been held this week to review prices, but at the time of writing the decision arrived at was not known. As regards works coal manufacturers are still experiencing a scarcity and a disposition to exact high prices.

Edge Tool Trade.

The edge tool industry in this district is running on something of the character of a switchback course. A few weeks ago the local firms were very busy, but they now report a falling off of orders. Indeed, business has gone quite flat, but whether or not it is merely a temporary lull is not known. The condition is, at any rate, only in keeping with the spasmodic behaviour of the market for a very long time past, and it seems impossible to induce buyers to enter into long or continuous contracts, such as would lead to greater stability. Consequently the makers, who are at present finding their costs of raw material and fuel difficult to settle on a fixed basis, are still unable to look far ahead. The export markets have been uniformly dull.

Birmingham Brass Trade.

The Birmingham brass trade is fairly busy just now, and sales of the better class of goods, in both the home and export markets, show a slight improvement. The Brassfounders' Employers' Association has announced a 5 per cent. increase on all classes of brassfoundry work, owing, it is stated, to the increased cost of labour, fuel and materials.

Unemployment.

The latest returns, made up to May 5th, show there are 120,835 persons unemployed in the Midlands, as compared with 123,888 a week before. The number is distributed as follows:—Men, 86,709; boys, 1984; women, 28,896; girls, 3246. To the total Birmingham supplies 30,913; Bilston, 2739; Coventry, 1726; Cradley Heath, 3739; Dudley, 3598; Smethwick, 4178; Stourbridge and Brierley Hill, 3170; Walsall, 5881; West Bromwich, 2549; and Wolverhampton, 6002.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE markets here for iron and metals do not show much sign of approaching recovery, and, generally speaking, the depression, especially as regards non-ferrous metals, tends to become deeper. The effect of the reasonable character of the Budget is wearing off, but there is a good deal of difference of opinion as to the result on trade of the abolition of the McKenna duties. The movements in the continental exchanges are somewhat alarming and it seems possible that the reckless speculation in the franc which led to such trouble in the metal markets earlier in the year is beginning again. Continental business in iron and steel is hindered by the fluctuation, but buying of cheap steel from the Continent is more seriously hindered by the unfortunate fact that no reliance whatever is to be placed on promises of delivery.

Metals.

The general position in the non-ferrous metal market here is very unsatisfactory, and it is to be noted that any confidence which might have been growing has received a check. Almost everybody is agreed that copper is too cheap, but very few people are prepared to back their views by holding larger stocks of the metal. During the past two years the copper market has had so many disappointments that disinclination to buy more than is required for prompt use is natural enough. Sellers of copper have "cried wolf" to the consumer so often, and the "wolf" does not materialise; but, as in the old story, the wolf will come sooner or later, and the consumer will be caught. So far as the position is known at present, it would appear that the efforts in America to curtail the production of copper have been countered by the falling off in American consumption. Optimists in the copper

market are now basing their expectations on a steady increase in European consumption, but just now the irregularity of the continental exchanges is a difficulty in the way of selling. Prices for standard and refined copper have not yet quite reached the low level of the early part of the year, but they are not now very far off, and the kindred metals—tin, lead and spelter—are very much lower than they were then. It is noticeable that dealers in scrap copper, gun-metal and brass are very reluctant to pay more than the lowest possible price for any lots that they buy. Their selling prices have not been reduced, but they seem to want an extra margin of apparent profit to cover the risk of their dealings. In Manchester, for instance, it is difficult to find a dealer who will pay more than £46 per ton for gun-metal scrap or £56 for clean copper scrap. The latter, of course, is much nearer the intrinsic value than the former; but both gun-metal and yellow brass have long been sold at very much below intrinsic values. The fall in the tin market since the middle of March, or in the brief space of two months, has amounted to about £70 per ton, and still there is no definite sign that the downward course of prices is likely to be arrested. No one here professes to have any opinion upon this market, but it is noticeable that those who were formerly confident that what may be called the "exchange *debacle*" was a temporary phase, are now silent. Even sellers of tin now admit that a level of £200 is a possibility. Lead has been in rather an uncertain mood, and it is difficult to say whether the downward movement is yet stopped. American buying is reported to be much smaller than it was. Spelter has been depressed in sympathy with other metals, but one is inclined to think that the prospects for the future are better in this market.

Pig Iron.

The demand for foundry iron in this district is still very small. It is largely of a hand-to-mouth character, and cannot in the aggregate be equal to the present output of the Midland furnaces; but a good many of these are working on old contracts made during the buying activity which preceded the Easter holiday, and hence, so far as one can hear, the furnaces are not yet being embarrassed by any great accumulation of stock. There have been one or two instances lately where a price a little under 95s., at the furnaces, has been accepted for No. 3 foundry iron, but these cases still seem to be exceptional, and as a rule Derbyshire makers are steady at 95s. The question of furnace coke supplies is still uncertain, and some makers of iron think that there is a chance of higher prices, say, up to 26s. per ton, as against the 24s. which has been the nominal figure for so long. This will be of considerable importance if North Country coke becomes cheaper, for it may mean a renewal of the competition of Cleveland iron in our markets. However, while the uncertainty prevails, neither buyers nor sellers here are at all anxious to negotiate for far forward deliveries of pig iron. The other Midland irons, Lincolnshire, Northamptonshire and Staffordshire, are all, when delivered in Manchester, at about the same level as Derbyshire foundry. Scotch foundry iron is firmer here, and for the finest brands up to 118s. 6d. delivered is asked.

Steel.

Manufacturers of steel are still in want of orders, although it is difficult for them to compete very keenly in the matter of price, simply because there is no margin of profit to be played with. One finds no appreciable change in the quotations. Common plates are at £10 2s. 6d. to £10 5s. per ton; boiler plates at £13 10s.; joists and angles at £9 12s. 6d. to £9 15s., although one has heard of £9 10s. in this connection. In manufactured iron, it is said by some people that the position is a little better, and that this has led to better buying of forge pig iron and scrap. The selling price of forge pig iron is, however, still some 7s. 6d. per ton below that of foundry, when it ought to be only 1s. per ton below.

Scrap.

Buyers of cast iron scrap are still very indifferent to the advantages of this cheap material. In some cases, however, one notices that dealers are a little stiffer, or at any rate not quite so weak as they were. The prices quoted for broken machinery cast iron range from 87s. 6d. to 92s. 6d. per ton delivered. Heavy steel melting scrap remains quiet, but not so weak as it was a fortnight ago. Dealers here are paying up to 75s. per ton on trucks, and this looks as if they hoped to find buyers in Sheffield at 90s., or at least 87s. 6d. per ton. Heavy steel turnings appear to be worth about 72s. 6d. per ton. Cast iron borings have been in demand, and up to 77s. 6d. per ton has been paid for them. Heavy wrought scrap is not now too plentiful, and the Lancashire ironworks have been paying 105s. per ton for good lots delivered.

BARROW-IN-FURNESS.

Hematites.

There is just a little better show of confidence in the hematite pig iron trade, and there is the hope that the corner has again been turned, and that there will be a fuller run of business in a short time. Apart, however, from an increased demand on the part of Workington steel makers, no increased business is being done, and the total production of iron remains on a low level. There is no iron being produced at Barrow and a fairly large tonnage in stock has yet to be disposed of. All business is being carried on from hand to mouth, with no tendency to place orders for future delivery. Overseas trade is quiet, but a shipment of pig iron has just been made from Barrow to Philadelphia. Charcoal iron is in steady request, but the output is of necessity only small. Iron prices show no change.

Iron Ore.

There is only a moderate demand for hematite iron ore, and in the mining areas there is a want of activity noticeable at most of the pits, both in North Lancashire and Cumberland. There is a certain amount of business being done on outside account for high-grade ores, but there is nothing being done at present in Spanish ores.

Steel.

After standing idle for many weeks, the rail mills at the Moss Bay Steel Works at Workington are again engaged, and can run to Whitsuntide on the orders in hand. The Barrow Steel Works remain closed, and there is no immediate prospect of a restart. The only activity at Barrow is in the hoop mill, where hoops and steel sections are being rolled, largely on overseas account. The demand for steel rails is very quiet, and competition is very keen all round.

Shipbuilding and Engineering.

These trades will shortly be much better employed in most departments than of late when orders recently secured are put in hand. On Tuesday next, Vickers Limited will launch from the Barrow shipyard the Orient steamer Orama. She is of 20,000 tons, and will run on the London and Australian service.

Fuel.

There is only a moderate demand for coal, and less East Coast coke is being used than has been the case for some time. Cumberland cokes are in steady demand in the county.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

THERE is nothing very new to report with regard to the condition of the heavy branches of the steel trade, which produce semi-finished material for the use of machinery builders, and also supplies for railways. The large plants of Siemens furnaces continue to be employed to a considerable extent, but new orders come in very slowly. Since the beginning of the year business has not kept up to the standard which was set during the last month or two of 1923. So much is this the case that difficulty is now experienced in securing enough orders to keep the furnaces going, and unless things improve there is a danger of some of them going out of commission. One of the big Lincolnshire steel works has already found it necessary to reduce output for want of orders. The reports that one gets from scrap merchants confirm the rather pessimistic outlook of the steel makers. No considerable tonnage of scrap has been bought by the open-hearth steel trade for the past two months. Holders, however, are not attempting to force sales at cut prices. They prefer to wait, in the hope that the demand will increase. There is not a great deal of scrap in the country, as the engineers' shops and shipyards are only producing small quantities.

Tool Trades Better.

If the side of the picture which I have already painted is but dull, there is another side, which relates to the finished branches of the steel trade, that is much brighter. Some of these branches have made excellent progress of late. For saws, and hand tools of every description, a steady but constant increase in demand is reported. The same is true of files, but here competition is so extremely keen that the trade can hardly be said to be of a remunerative character. The rivalry of the United States in this trade, and the cheap rates at which the makers in that country are prepared to sell, is a formidable factor. For milling cutters and screwing tackle the works are finding a much better demand than they enjoyed a year ago. The improvement in this branch is less marked than in some others, but the prospects are good. The bulk of the surplus war stores is now exhausted, and new supplies are being more and more needed, so that the trade can look forward to the future with confidence.

Cutlery Trade Quiet.

The cutlery trade continues to remain in a very unsatisfactory position. Business is being obtained in what may be termed "scrappy" fashion, and manufacturers are longing for a return of the days when they could look for a steady stream of orders from definite sources. High-class work is not in much demand, and the firms that are busiest are those catering for the cheap market. But even here profits are small on account of the keenness in competition. It is interesting to note that the value of cutlery being exported from this country is gradually moving upwards. For the first four months of this year the value was £269,851, compared with £255,662 for the corresponding period last year, and with £245,165 for the 1922 period. Although the increases are small, they indicate a move in the right direction. Stainless knives are one of the best features of the market. Scissor makers are fairly busy, but manufacturers of razors and small knives are not finding much work, except in the case of one or two firms with special trade connections.

Maltby Pit Developments.

Since the disastrous explosion at Maltby Main Colliery last July, when twenty-eight miners were killed, the work there has been seriously handicapped because of the necessity of shutting off part of the workings as a precautionary measure. During last week-end, when the men had left the pit in the ordinary way, a picked party undertook the dangerous task of getting through into the old workings by removing one of the explosion doors 600 yards further back. The work was carried out by about thirty men working in short shifts. Rescue parties stood by, but their services were not needed, and the work was completed without mishap in twenty-four hours, which was ten hours less than the anticipated time. Mr. B. Pickering, the agent at the colliery, states that the effect of this action will be to open out 600 yards of coal face in a rich seam. Many of the men who were thrown out of employment after the explosion and got other work are now returning, and Mr. Pickering states that ultimately it is hoped to absorb more and more men, and still further increase the output.

Broken Rope Mystery.

The other big Sheffield pit disaster last year—that at Nunnery Colliery, where seven men were killed as a result of a "paddy" train rope breaking—has also been recalled by the Government inquiry. Professor Douglas Hay, of Sheffield University, stated that at the point where the rope broke he found that eight out of the forty-two wires were broken before the accident. These were all inside, and the rope had probably been injured at that point. But even then the rope had a safety margin of 8 tons, and he could not explain why it broke. Professor C. H. Desch, the well-known metallurgist of Sheffield University, stated that a system of a magnetic nature, to discover broken strands in the interior of a rope, was being investigated.

Order for Lincoln Firm.

Ruston and Hornsby, Limited, of Lincoln, have received orders for six of their mammoth drag-line excavators for India. A sum of £130,000 is understood to be involved in the contract. This may be regarded as a repeat order, consequent upon the satisfactory work accomplished by the drag-line machines previously built by the firm for the construction of waterways in India for irrigation purposes.

Electricity Supply.

As a result of conferences between the Sheffield and Rotherham Corporations, the former has been recommended to accept the suggestion of the Electricity Commissioners that an advisory board should be formed for the North-East Midlands Electricity District. The Town Clerk has received instructions to prepare a draft order for the formation of such a board, and to submit it to the Commissioners.

New Market for Derby.

A sum of £15,000 is to be paid by Derby Town Council for the Government Instructional Factory in Nottingham-road, which it is proposed to use as a wholesale market. In addition, there will be an expenditure of from £5000 to £6000 in acquiring a piece of land from the London, Midland and Scottish Railway in order to obtain better access to the property.

Gas Company to be Sold.

The directors of the Dronfield Gas Light and Coke Company report that a provisional agreement has been entered into with the Sheffield Gas Company for the sale of the company's business and all its assets as from December 31st last for £20,000. The debenture shares will be paid off in full, and the other shareholders will receive 80 per cent. of their holdings and interest at the rate of 5 per cent. free of tax until the purchase is completed. The agreement will be submitted to the shareholders following the annual meeting.

Engineering Appointment.

Colonel A. C. Thompson, A.M. Inst. C.E., who has been an assistant engineer in Rotherham borough, has received an appointment as chief engineer to J. J. Habershon and Sons, Holmes Mills, Rotherham. In this firm's monthly journal it is stated that the appointment has been made "in view of some developments which are very likely to take place in the course of a few months' time, affecting our transport system and the development of our engineering department generally."

Bridge Reconstruction.

Work has been begun in Sheffield this week on the reconstruction of Staniforth-road bridge, in order to facilitate traffic and to open out a "bottle-neck." There is a single tram track at this point, and the bridge is very old, and is not strong enough, in view of the weight of present-day traffic. The bridge will be reconstructed in two sections, in order that pedestrian and vehicular traffic will be able to cross during the rebuilding. The bridge will be widened by 20ft., and a double track of tramlines will be laid down. The contract has been given to Wellerman Brothers, Limited, of Attercliffe, Sheffield, at an estimated cost of £8750, and the bulk of the labour is to be obtained from the labour exchange. Mr. E. Partington, the city's improvement surveyor, will supervise the carrying out of the work. Bridge building is also in view by the West Riding County Council, which has agreed that, subject to the Ministry of Transport contributing £5200 and the Sheffield and South Yorkshire Navigation Company £1000, a sum not exceeding £9000 be expended in constructing at Thorne a new bridge to carry the Bawtry and Selby main road over the canal.

Iron and Steel Institute's President.

Sir William Ellis, of Sheffield, who has recently been elected to the presidential chair of the Iron and Steel Institute, can probably claim to be one of the world's best-known men in the steel trade. He is managing director of John Brown and Co., whose service he entered in 1887, after completing the erection of the first forging press installed by that firm. In the next few years he developed the manufacture of marine shaftings and forgings, which has added so substantially to the reputation of his firm for this class of work. Sir William served an engineering apprenticeship of five years in Leeds. Subsequently he had considerable experience abroad, and for a long time was engaged in erecting machinery and plant in the eastern part of Serbia. Sir William holds the degree of Doctor of Engineering of Sheffield University. During the whole period of the war Sir William Ellis was Master Cutler of Sheffield. The Government during that time made full use of the Cutlers' Company and of the Master, whose wide knowledge of the steel industry proved of tremendous value. For this work Sir William received the high honour of a Knight Grand Cross of the Order of the British Empire, and also had conferred upon him the Commandership of the Crown of Italy.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Disturbed.

THE flow of international business, which has been an encouraging feature in the Northern iron and steel trade during the past month or so, has been rudely disturbed by recent events on the Continent. The exchanges, which had attained a certain measure of equilibrium, have again been subject to violent oscillations, and the effect has been to nip in the bud negotiations with regard to iron and steel contracts. The disturbance, it is hoped, is only temporary, and a recovery of the franc—by no means an improbable event as soon as the political horizon clears—would immediately bring French buyers on the market again.

Cleveland Iron Trade.

Business has been extremely quiet in the Cleveland pig iron trade this week, but inactivity is not unusual just about this period of the year. The situation, however, cannot be regarded as worse than it has been, though the undertone of confidence is slightly less marked, as continental firms are making a greater effort to compete for orders. Price concessions by French, Belgian, and Luxemburg manufacturers, though as yet not sufficient to be very disquieting, are having some effect on this market. The strike in the Ruhr and the political disturbance in France have caused an almost complete suspension of foreign business, and home consumers prefer to exercise a watching brief. Prices, however, are firmly maintained, sellers asserting that further concessions are impossible. For No. 3 G.M.B. Cleveland pig iron 91s. 6d. is absolutely a rock-bottom f.o.t. price, but 92s. is more generally quoted. No. 1 foundry is 97s. 6d.; No. 4 foundry, 91s.; and No. 4 forge, 90s.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade shows little alteration on the week. Business is certainly not so active, but makers have done fairly well recently, and heavy stocks have been liquidated to a considerable extent. Mixed numbers are firmly quoted at 99s., with No. 1 quality at 100s.

Ironmaking Materials.

Distinctly easier freight rates give promise of slightly lower prices for foreign ores. Advantage has been taken of the extra tonnage available to charter a number of vessels at lower rates, but there is still no new buying of foreign ore, and best Rubio ore remains nominally at about 23s. per ton c.i.f. Tees. The coke trade position is easier, and good medium furnace qualities can be purchased at 28s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The most encouraging feature of the manufactured iron and steel trade is the steadier flow of specifications for shipbuilding materials. There is distinctly more inquiry for new ships, and shipyards are working so much better that mills rolling this class of material are more fully employed. There are, however, plenty of cheap German billets about once more, and the steel export trade is very slack owing to the obscure financial situation. Prices are unchanged.

The Coal Trade.

The position in the Northern coal trade is one of great uncertainty and difficulty, and very discouraging in view of the fact that there is a good inquiry circulating. Numerous Scandinavian gasworks are seeking offers for supplies in monthly quantities for June and July shipment. There are also several larger gas orders circulating. Steam coals for contract supplies over the next few months are also being pressed on the market, but the threatened labour troubles are preventing business, both buyers and sellers being afraid to operate. The threatened stoppage by the trimmers and teemers has almost brought business to a standstill, as, if a strike takes place, shipments would immediately cease, and the collieries would be laid idle. While this is the most urgent problem, the miners' negotiations with the owners are causing uneasiness, since the statements of the leading miners' officials do not point to a friendly meeting. The German miners' stoppage is apparently not likely to be settled for some days, and meantime a demand from Germany has set in, but sellers on this side cannot guarantee deliveries until the port labour dispute is settled. Thus business is seriously held in abeyance and coal values are checked. The whole position is thoroughly disappointing to merchants, who anticipated an improved trade for the summer months. With regard to the threatened home ports' labour stoppage, the question is asked why the Government does not step in and take some definite action instead of apparently waiting until the movement has taken full effect. With these uncertainties ruling coal prices show no improvement, and prices are nominally unchanged. The coke trade remains idle and sellers offer supplies freely at discounted rates.

SCOTLAND.

(From our own Correspondent.)

Firmer Tendency.

WHILE the volume of business in the steel and iron trades has not increased to any extent, a better feeling has been apparent with regard to the future. Prices in general are practically unchanged, but a firmer tendency is noticeable.

Pig Iron.

Quiet but steady denotes the position in the pig iron market. The export inquiry has expanded a little, and some small quantities have been sold for continental delivery. On the whole, forward buying is far below expectations. Prices, generally, show no change, but as much as £5 15s. to £5 18s. per ton has been named for certain brands.

Steel and Iron.

A slight improvement has been noticeable this week in certain departments of the steel trade. The plate mills continue rather quiet, but an improvement in sections is reported. Steel sheets have a fairly steady turnover, chiefly in the lighter varieties. Bar iron also has progressed a little. Export remains on the dull side, but the home trade shows signs of opening out. The quotation of £12 10s. per ton for Crown bar iron still stands, but it is reported that angles have been sold at £12 15s. per ton home delivery and £12 5s. per ton net f.o.b. Glasgow, while tees have been quoted at £13 and £12 10s. per ton respectively. It is also stated that some small rounds and squares were sold to Japan at prices ranging from £10 to £10 5s. per ton. The demand for re-rolled steel improves. The scrap trade is steady, all classes being in better inquiry.

Dispute at Glasgow Steel Works.

As a result of the proposal by the management of the Blochairn Steel Works, Glasgow, to introduce a system of payment by contract in the plate mills, 1500 members of the Iron and Steel Trades' Confederation were instructed to cease work. The steel workers generally are strongly against the contract system. The General Council of the Scottish Trades Union Congress takes the view that the contract system is injurious to the best interests of the workers, and has passed a resolution in support of the Confederation.

Coal.

During the greater part of the week the coal market continued weak and inactive. Buyers, generally, were more anxious to work off accumulated stocks than to entertain fresh negotiations. The collieries in all districts have found great difficulty in getting sidings cleared, and consequently there has been a scarcity of empty wagons, and a considerable amount of idle time. Buying on German, French and Italian account has been small, and the prices offered have evidently given little satisfaction. A little more business has been placed on Scandinavian account however. Inquiries from other directions are apparently intended merely as a test of the market, as practically no business has resulted. Within the last day or two a slightly firmer note has been struck, due, it is believed, to the reports from the Ruhr and Westphalia, but it is yet too early to anticipate any results from the situation which has arisen there. At present the collieries in Lanarkshire have a fairly good market in the Irish demands, but the East of Scotland districts are not so well placed. The Fifeshire collieries have sold some fair lots recently, but along with the collieries in the Lothians are suffering from an accumulation of stocks. The latter are further handicapped by the coal trimmers' dispute, which has unfortunately assumed alarming proportions. Aggregate shipments from Scottish ports during the past week amounted to 271,861 tons, against 231,007 tons in the preceding week and 352,372 tons in the same week last year. Compared with last year, shipments for this year to date show a decrease of over 1,600,000 tons. The home market is particularly slow, especially with regard to industrial fuel.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal trade have been very unsettled this week, and the cause of this is the uncertain outlook. The position has been accentuated by reason of the difficulty of gauging what may happen between the coalowners and the miners' leaders regarding the new agreement, and the unexpected development of a threatened strike on the part of the coal-trimmers and tippers throughout the country. While the miners' leaders are disposed to make the most of the Buckmaster report of the recent inquiry, it is easy to see that they are very disappointed. Their chief grievance is, of course, that the findings of the Court were not put into definite recommendations and they are, therefore, deprived in a way of a useful weapon with which to attack the coalowners. In certain respects the report is favourable to both parties and, strictly speaking, the position is "as you were." It is a case of the coalowners and the miners' leaders resuming their negotiations on the new wage agreement where they left off, and as at that time there was not much between them there should be no insurmountable difficulty in coming to terms. One interesting point is whether Mr. Herbert Smith and the more moderate leaders will be able to keep the Miners' Federation to the pledge which he gave before the inquiry, that the Federation would accept the decision of the Court and its findings. If this is the case then one is justified in regarding the outlook as somewhat hopeful; but if such is not the case then grave fears are entertained that trouble will be experienced.

Trimmers' and Tippers' Threat.

The threat of a national stoppage of work on the part of the coal-trimmers and tippers has caused a good deal of annoyance and difficulty in coal trade circles, and it is generally contended that the men are not warranted in creating such an amount of disturbance of industry on a matter which is of purely local interest to Leith. There were mass meetings of the workmen in question at South Wales centres on Sunday last, when the position was explained to the men, and in all cases the meetings resolved to come out on strike in sympathy with the Leith workmen. Whether these decisions were fully warranted is a moot point, as it is stated that the meetings were not largely attended, and that in one case about 1500 men were committed to strike action by an attendance of about 170 men. A ballot of the whole of the workmen would have been a fairer means of testing the feelings of the trimmers and tippers. At the moment of writing it is not known whether the Government efforts at mediation have succeeded in averting a strike, but if such is not the case and the workmen down tools on Wednesday night then it will not be long before about 10,000 workmen in the South Wales district will be idle, and by the end of the week it will mean that practically the whole of the coalfield will be at a standstill, as the supply of empty wagons will not permit of the miners working more than a few days, as standing stocks of coal are already heavy, and, furthermore, shipowners, wherever they are in a position to do so, are diverting their steamers and looking for freights from the continental ports, where there is not the risk of their steamers being held up. The fact that tonnage is being diverted from South Wales means that the ship-repairing undertakings are suffering, so that there will be less work for the boilermakers and all the other grades of workmen employed in the engineering yards and dry docks.

LATER.

The news was received at Cardiff on Wednesday afternoon from London that, instead of the trimmers and tippers ceasing work at ten o'clock that night, they were to continue at work pending further instructions. This decision, while regarded as satisfactory up to a point, was viewed with disappointment, as it meant prolonging the period of uncertainty. At the same time the general belief prevailed that the threatened national strike of trimmers and tippers would not mature, as if the men do come out the probability is that the employers will insist on a number of other important questions being settled, such as a revision of the tariff, &c. Meantime business on the steam coal market is quiet, though as the result of improved tonnage supplies in dock best Admiralty large coals are steadier at 28s. to 28s. 6d.

Steel Trade and Tariffs.

A private conference of the divisional council of the Iron and Steel Trades' Confederation held at Newport, has decided to call on the Government to set up a special committee to inquire into the economic difficulties of the iron and steel trade. This was the result of consideration being given to a lengthy memorandum received from headquarters. This document raised the question of Free Trade *v.* Tariff Reform, but the undivided opinion of the delegates, it is stated, was that it would be inadvisable to accept the principle of tariffs until stronger evidence was submitted that they would be beneficial.

Current Business.

Operations on the steam coal market have been brought to practically a standstill owing to the untoward developments arising from the threatened strike of the coal-trimmers and tippers. This threat has come at a time when business is difficult enough, and until the outlook becomes clearer exporters will be more cautious than ever in entering into fresh commitments. The position of the collieries was slightly improved at the beginning of this week as compared with last week, when there were no less than 29 loading berths vacant at the various ports in this Channel. Arrivals of tonnage over the week-end made things better, but it is to be feared that the improvement is only of a temporary character, and that before very long the need of collieries will be for ready tonnage. Even now many undertakings have great difficulty in avoiding pit stoppages, and prices are very irregular. Collieries producing Admiralty quality coal are better placed than those producing other grades, but even best Admiralty large coals are scarcely worth more than 28s., if indeed supplies cannot be secured through middlemen at a shade less. Small coals continue to be relatively steadier on account of the limited outputs. One or two small orders have been obtained by local undertakings for the supply of Admiralty coals for Scandinavian railways, and tenders had to be in on Wednesday for 150,000 tons of large steams for the Egyptian State Railways. The result of this tendering will be awaited with interest, as there is no doubt that firms have been much exercised in mind as to what risks can be taken in view of the uncertain outlook, and the fact that the coals have to be shipped over a period of five months, from June to October.

CATALOGUES.

HENRY HUGHES AND SON, Limited, 57, Fenchurch-street, E.C. 4.—Pamphlet on the dead-beat compass (patent) which is claimed to save fuel, time and distance.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, Falcon Works, Loughborough.—Copy of new edition of catalogue dealing with Brush-Ljungstrom turbo-generators.

DOWDINGS' MACHINE TOOL REGISTRY, *Morning Post* Buildings, Strand, W.C. 2.—Register of over 1500 new and second-hand machine tools ready for delivery.

GWYNNES ENGINEERING COMPANY, Limited, Church Wharf, Chiswick, W. 4.—New pamphlet on Gwynne cars, 1924. Illustrations, details and prices are included.

CRANE-BENNETT, Limited, 45-51, Leman-street, London, E. 1.—Catalogue No. 5, valves, pipe fittings, steam specialities, heating sanitary and oil engineers' supplies.

DAVID ASHTON AND CO., Limited, Aztec Works, Neepsend, Sheffield.—Leaflet on Aztec grinding and polishing machinery for the saw manufacturing and steel trades.

ROBSON REFRACTORIES, Limited, 1, North-road, Darlington.—Booklet entitled "Useful hints to foundrymen," in which cupoline refractory lining material is described.

ROYAL INSURANCE COMPANY, Limited, 1, North John-street, Liverpool.—A copy of the firm's illustrated prospectus, "Road Risks Illustrated," issued by the motor department.

KASENIT, Limited, 8 and 9, Ludgate-square, Ludgate-hill, E.C. 4.—Catalogue of Kasenit case-hardening compounds, rust prevention and cleaning of metals and appliances.

CROFTS (ENGINEERS), Limited, Bradford.—Reduced edition of catalogue containing information of great service to those engaged in the laying out or supervision of power transmission installations.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 20/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 2 6	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 19 0	4 19 0
No. 1	5 0 0	5 0 0
Cleveland—		
No. 1	4 17 6	4 17 6
Siliceous Iron	4 17 6	4 17 6
No. 3 G.M.B.	4 11 6	4 11 6
No. 4 Foundry	4 11 0	4 11 0
No. 4 Forge	4 10 0	4 10 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 7 6 to 4 10 0	
" " Foundry	4 15 0	—
(3) Northampton—		
Foundry No. 3	4 12 6	—
" Forge	4 5 0 to 4 6 0	
(3) Derbyshire—		
No. 3 Foundry	4 13 6 to 4 15 0	
Forge	4 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 14 6	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 12 6 (a) / 5 17 6 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best "	—	—
N.E. COAST—		
Common Bars	12 10 0	—
LANCS.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best "	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ¾in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 5/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light "	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
" (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
" (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
" (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 5 0 to 10 10 0	
Billets and Sheet-bars	8 2 6 to 8 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 5 0	
Angles	9 17 6 to 10 0 0	
Joists	9 17 6 to 10 0 0	
Tees	10 17 6 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/9 to 24/-
Block Tin (cash)	225 0 0
" (three months)	224 5 0
Copper (cash)	61 17 6
" (three months)	62 5 0
Spanish Lead (cash)	29 5 0
" (three months)	28 2 6
Spelter (cash)	31 5 0
" (three months)	31 12 6
MANCHESTER—	
Copper, Best Selected Ingots	67 10 0
" Electrolytic	68 5 0
" Strong Sheets	98 0 0
" Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0½
" Condenser	0 1 2½
Lead, English	31 0 0
" Foreign	29 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
" 6 p.c. to 8 p.c. "	£23 10 0	8/-
" 8 p.c. to 10 p.c. "	£22 0 0	8/-
" Specially Refined		
" MAX. 2 p.c. carbon	£42 10 0	16/-
" " 1 p.c. "	£51 0 0	17/6
" " 0.75 p.c. carbon	£75 0 0	20/-
" carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
" Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
" " 75 p.c.	£18 0 0 scale 6/- per unit	
" Vanadium	19/9 per lb.	
" Molybdenum	8/6 per lb.	
" Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	20/-
" " Ell	22/3
" " Splint	22/9 to 24/6
" " Trebles	22/6
" " Doubles	21/6
" " Singles	18/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	20/-
" " Splint	22/9
" " Trebles	22/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	19/9 to 23/-
Screened Navigation	26/-
Trebles	23/3
Doubles	22/-
Singles	18/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	21/9
Secondary Steam	20/3
Trebles	22/9
Doubles	21/9
Singles	18/-

ENGLAND.

(8) N.W. COAST—	
Steams	32/-
Household	49/- to 59/-
Coke	35/-
NORTHUMBERLAND—	
Best Steams	23/6
Second Steams	22/- to 22/6
Steam Smalls	15/- to 15/6
Unscreened	20/- to 21/-
Household	27/-
DURHAM—	
Best Gas	23/6 to 24/-
Second	21/-
Household	27/-
Foundry Coke	26/- to 28/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/- to 37/- —
Barnsley Best Silkstone	31/6 to 33/6 —
Derbyshire Best Brights	29/6 to 32/6 —
" " House	26/- to 28/- —
" " Large Nuts	25/- to 26/- —
" " Small "	19/6 to 22/- —
Yorkshire Hards	25/- to 27/6 —
Derbyshire "	23/- to 25/- —
Rough Slacks	12/6 to 15/6 —
Nutty "	12/- to 14/- —
Smalls	8/- to 10/- —
Blast-furnace Coke (Inland) *	
" " (Export)	f.o.b. 30/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/- to 28/6
Second " "	27/- to 27/6
Best Dry Large	27/- to 27/6
Ordinary Dry Large	25/6 to 26/6
Best Black Vein Large	26/6 to 27/-
Western Valley "	26/- to 26/6
Best Eastern Valley Large	25/6 to 26/6
Ordinary " "	25/- to 26/-
Best Steam Smalls	18/- to 19/-
Ordinary "	16/6 to 18/-
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	28/- to 29/-
" " Smalls	24/- to 25/-
No. 2 " Large	24/6 to 25/6
" " Through	21/- to 23/-
" " Smalls	16/- to 17/-
Coke (export)	50/- to 57/6
Patent Fuel	29/- to 30/-
Pitwood (ex ship)	24/6 to 26/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	45/- to 47/6
Seconds	40/- to 42/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	52/6 to 57/6
Nuts	45/- to 55/-
Beans	45/- to 47/6
Peas	27/- to 29/-
Breaker Duff	11/3 to 11/6
Rubbly Culm	16/- to 16/6
Steam Coals:	
Large	24/- to 26/-
Seconds	22/- to 24/-
Smalls	15/- to 18/-
Cargo Through	18/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Blast-furnace Coke (Inland): Special Price for Ironworks 23/-, open market 28/-. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade and Exchange.

THE level at which the franc was maintained for more than two weeks inspired so much confidence in a further early improvement, that the heavy set-back during the past few days has given rise to serious apprehension. The falling off in business activity was attributed to the sudden appreciation of the currency, which checked the foreign demand at a time when makers were unable to offer concessions for home orders, but as nearly all the engineering firms have a fair amount of work in hand, they were content to wait until the stabilisation allowed of prices settling down to a normal level. The further fall in the value of the franc has upset these calculations by showing that there is no real ground for the hope of a stablisation which will eliminate the element of speculation from business. So long as there remains a probability of sudden fluctuations in currency values, the prices of raw material can hardly weaken, and while those prices had a downward tendency when it was thought that the franc was appreciating by regular stages, they stiffened when the franc declined, and even though the set-back should be temporary, it will certainly retard the fall in raw material prices for some time to come. The drop in the franc is all the more to be regretted because British firms found that the improving exchange rate was enabling them to compete successfully in this market. It is not yet benefiting French makers, who fear that in the early future the situation will become critical, and if the franc should undergo further downward fluctuations, iron and steel makers may find themselves once more with a heavy foreign demand, when home engineering firms may be compelled to pay relatively higher prices than their foreign competitors.

Rolling Stock.

The orders being given out for wagons are far from providing adequate employment to builders. The Cie du Nord has divided an order for a thousand coke trucks between the Ateliers du Nord de la France and the Cie Française de Matériel des Chemins de Fer, and some small orders have been distributed for all-steel trucks, which are being employed on an increasingly large scale. The productive capacity of the locomotive and wagon building shops is, however, so considerable that work cannot be found for them unless the railway companies renew their old stock and increase it to meet the growing traffic requirements. The companies have so far purchased very little on the plea that the financial situation will not allow of their embarking upon any heavy expenditure. Two big financial concerns have therefore been constituted with the idea of providing the funds necessary for the construction of locomotives and wagons. One of these concerns represents practically all the locomotive and wagon builders in the country. The railway companies, presumably, would be relieved of any immediate financial burden, since the locomotive and wagon builders would be paid by the new concern, which would recoup itself with yearly instalments from the companies under State guarantee. The second of these financial concerns represents the makers of brakes, and its object is to finance in the same way the equipment of goods wagons with Westinghouse continuous brakes in accordance with the recommendation of the Commission appointed by the Ministry of Public Works soon after the Armistice. The railway companies, however, do not seem disposed for the moment to fall in with the suggestions of the two financial companies, on the ground that the deficit in railway working must be made good by the increased receipts arising from the higher railway rates before any further heavy expenditure can be authorised.

The Stadium Railway.

The electrification of the railway from St. Lazare to Colombes, where a station has been erected as near as possible to the Stadium, is undoubtedly a great convenience for those attending the Olympic Games, but the special fares charged for so short a distance are causing considerable dissatisfaction. The State Railways explain that these fares are necessary in order to recoup a part of the heavy expense incurred to ensure a temporary and intermittent service. There is certainly a tendency amongst a section of the public to boycott the line, and the next few months will show whether a railway company is justified in equipping a line temporarily for the benefit of an enterprise that does not offer any guarantee of success.

Suction Gas Tractors.

The practical results being obtained with heavy vehicles equipped with suction gas plants are so far encouraging that the Minister of War has decided to organise a trial of suction gas tractors under the same conditions as the trials of other vehicles for which subsidies are granted, when they fulfil certain requirements that render them useful for national defence. Those subsidies represent a notable diminution in the prices at which the vehicles are sold. The tractors are divided into two classes according to weight. On a journey of 40 kiloms. a tractor weighing not more than 4400 kilos. in running order—that is to say, capable of being carried on a 5-ton lorry—must not consume more than 500 grammes of charcoal per kilometre-ton, and, if water be used in the scrubber and for cooling, the quantity must not exceed 750 grammes. In the category of light tractors, weighing 2500 kilos. in running order, the consumption must not exceed 600 grammes of charcoal and 900 grammes of water.

Helicopters.

For the first time, a helicopter, constructed by M. Oemichen, at the Peugeot works at Valentigney, has flown officially in a closed circuit. It followed a triangular course of a little more than a kilometre in 7 min. 40 sec., remaining all the time at about a metre from the ground, except at the turnings, where it rose to 3 m. M. Oemichen receives a prize offered by the State for this performance.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

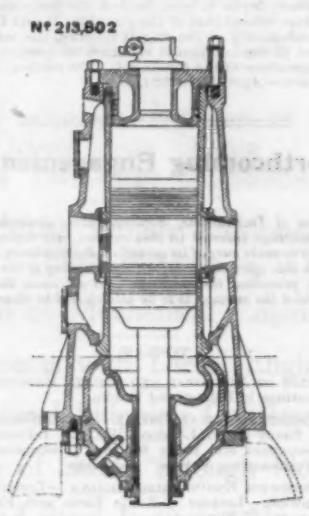
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

213,802. May 28th, 1923.—CYLINDER LINERS, The Wallsend Slipway and Engineering Company, Limited, Wallsend-on-Tyne, and J. S. Simm, Ashfield-grove, Monkseaton, Northumberland.

In this engine the cylinder liner is inserted from below and loose covers provided at both ends. The liner is held by a flange

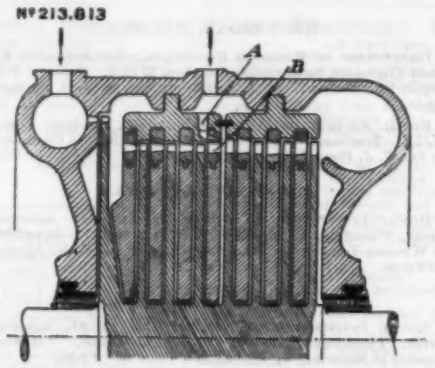


gripped between the lower cover and the jacket and is free to expand upwards. Water-tight joints are made between the liner and jacket by means of copper rings. The top cover extends into the liner, while the bottom one has recesses to form combustion chambers.—*April 10th*, 1924.

TURBINE MACHINERY.

213,813. June 19th, 1923.—BY-PASS TURBINES, Erste Brünner Maschinen Fabriks Gesellschaft, 5, Glockengasse, Brünn, Czecho-Slovakia.

This invention relates to turbines in which additional steam is admitted beyond the first stage, and aims at minimising the

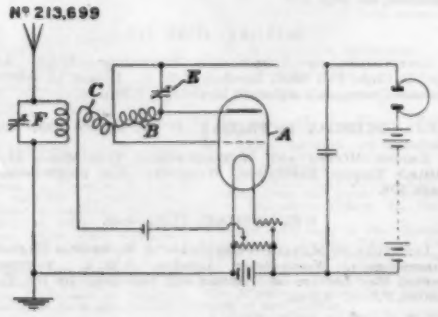


disturbance of one stream of steam by the other. The additional steam is consequently admitted through guide passages A which are entirely distinct from the guides B for the steam that has already done work in the turbine.—*April 10th*, 1924.

TELEGRAPHS AND TELEPHONES.

213,699. January 13th, 1923.—IMPROVEMENTS IN RADIO RECEIVING CIRCUITS, Paul Gustave Adolphus Helmuth Voigt, of Bowden Mount, 121, Honor Oak Park, S.E. 23.

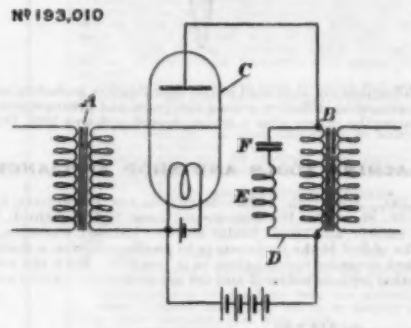
This invention would appear to offer advantages in the direc-



tion of reducing the oscillating troubles that are now being experienced from the use of wireless receiving sets by unskilled operators. The valve A has a tuned plate circuit B E, the initial position of which is such that it is not coupled to the input or aerial circuit F, and if the plate circuit should oscillate there will be no radiation from the aerial. The grid coil C is subsequently inserted as shown, and is situated so that it is coupled simultaneously to both the other coils, the voltage applied to the grid being a combination of the two induced voltages. Owing to the fact that the stray and self capacities in the grid circuit cannot be completely eliminated, these induced voltages will cause charges to flow in the grid circuit, and these charges constitute currents with a magnetic field of their own. This field threads the input circuit and produces an indirect coupling between the plate and the input coils, which is neutralised by an additional coupling in the opposite sense. Rectification is obtained by working on the lower end of the plate current curve. The invention enables signals to be reinforced without danger of radiating from the aerial, and in multi-valve circuits signals can be reinforced at each stage of the high-frequency amplification without making the circuit unstable. Another advantage claimed for the invention is that the wave length on which reinforcement occurs is only dependent on one tuned circuit.—*April 10th*, 1924.

193,010. January 10th, 1923.—TRANSFORMERS FOR THERMIONIC VALVE AMPLIFIERS, *C. Lorenz Aktiengesellschaft, of Lorenzweg, Tempelhof, near Berlin.*

This specification relates to a transformer for use with amplifying valves, the transformer being provided with a shunt designed to by-pass a substantial portion of the current above speech frequencies. In the diagram A is an input transformer and B

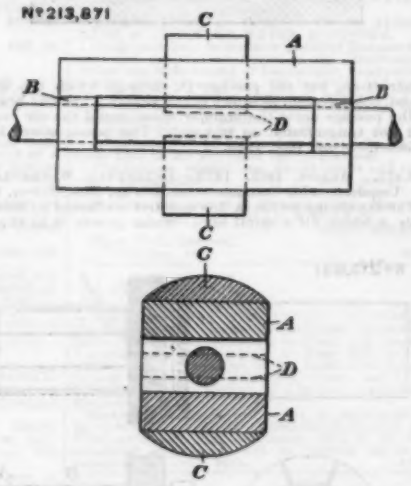


an output transformer, C a thermionic amplifying valve, and D a shunt comprising an inductance E and capacity F, which is connected to the winding of the transformer B. By suitably selecting the values of E and F and the ohmic resistance of the shunt the resonance curve can be altered as desired, so that the falling off of amplification beyond the range of speech frequencies can be made as steep as desired.—*April 10th*, 1924.

MOTOR CARS AND ROAD TRAFFIC.

213,871. January 10th, 1923.—IMPROVEMENTS RELATING TO MAGNETO-ELECTRIC MACHINES, The M-L Magneto Syndicate, Limited, and Ernest Ansley Watson, M.Sc., all of Victoria Works, West Orchard, Coventry.

This invention relates to magneto-electric machines, such as electric current generators or motors, in which permanent magnets are employed to furnish the necessary magnetic field. The object of the invention is to provide an improved permanent magnet system which is adequately safeguarded against demagnetising forces. A pair of bar magnets are arranged parallel with each other and joined magnetically at their ends, each bar having a free pole at or near its centre, the distance between the bars being such that the intervening gap provides



a shunt path of sufficiently low reluctance to protect the magnets against excessive demagnetisation. The drawings illustrate a two-polar permanent magnet rotor. The magnet system consists of two straight bars A of magnet steel, which are joined by soft iron B at the ends. The bars are parallel to the axis, and are provided with poles C at the middle. The system is arranged so that each bar has a pole in the middle, and the alternative path for the magnetic flux is provided by the proximity of the two bars, whereby the magnetic flux can cross the axis in the event of its not being able to pass round through the armature which surrounds the pole pieces in the usual way. This internal path may, if necessary, be reduced in length by the provision of internal poles D.—*April 10th*, 1924.

PUMPING AND BLOWING MACHINERY.

213,627. October 10th, 1922.—INTERNAL COMBUSTION PUMPS, W. Beardmore and Co., Limited, A. E. L. Chorlton, and W. J. Rusdell, 36, Victoria-street, Westminster.

In this pump, which is of the two-stroke cycle type, an effort is made to prevent pre-ignition of the charge by arranging a layer of air or cool exhaust gases between the charge and the products of the combustion of the previous charge. A is the gas inlet valve, B the air inlet, and C the exhaust. On the outstroke the

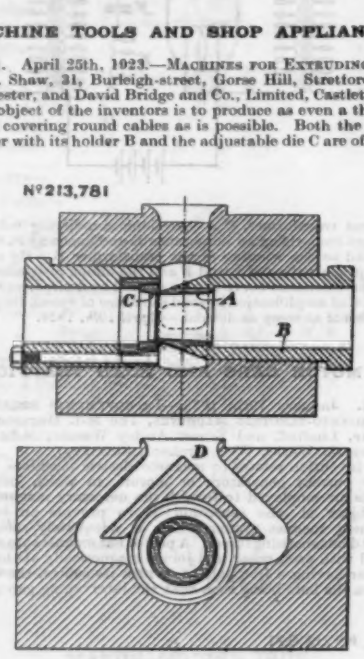
gas fills the chamber to the level D D, air is drawn in below to the level E E, while the remainder of the space down to F F—the level of the exhaust valve—is occupied by burnt gas. Several

modifications are indicated in the specification, including means for preventing diffusion among the gases and arrangements for agitating the charge after it is compressed.—*March 10th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

213,781. April 25th, 1923.—Machines for Extruding Lead, W. Shaw, 31, Burleigh-street, Gorse Hill, Strettord, Manchester, and David Bridge and Co., Limited, Castleton.

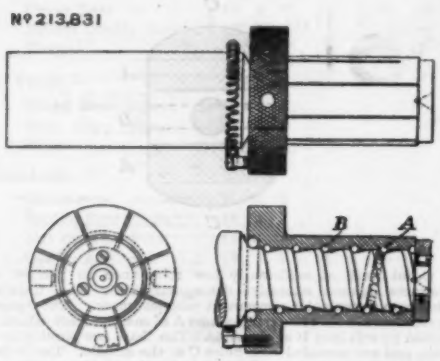
The object of the inventors is to produce as even a thickness of lead covering round cables as is possible. Both the core A, together with its holder B and the adjustable die C are of normal



construction, but the passage D, through which the lead is forced, is bifurcated, as shown in the section. The two branches of the passage enter the annular space round the die radially and not tangentially, as is usual. The passages are highly polished.—*April 10th*, 1924.

213,831. August 14th, 1923.—Expanding Mandrels, A. Urquhart, 274, Caroline-street, Derby, New Haven, Conn.

The expanding action in this mandrel is effected by means of balls A which fill a spiral semi-circular groove B in the split

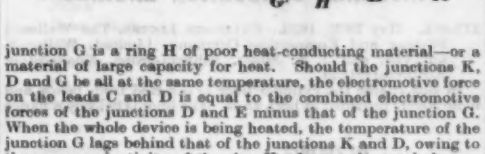


sleeve. A corresponding groove is cut on the spindle, but has a wedge-shaped bottom. When the spindle is screwed into the sleeve the balls are crowded into the shallower part of the groove and expand the mandrel.—*April 10th*, 1924.

MEASURING AND TESTING INSTRUMENTS.

213,868. January 5th, 1923.—Improvements in or relating to Thermo-electric Couples, Charles Philip Miller, of 100, Skipton-road, Ilkley.

The invention relates to improvements in thermo-electric couples, more especially to those for use in apparatus for indicating and regulating the temperature of furnaces. The couple is capable of exerting a high electromotive force with a given rise in temperature. Conversely, with a given drop in temperature the electromotive force set up by thermo-couple is lower than is the case with the ordinary type of thermo-couple. A represents the sheath, B and C the primary wires of the couple, which, in operation, are electrically connected to a galvanometer, the wires B and C being composed of any suitable metals having different thermo-electric properties. At the other end the wires are connected by welding at K and D to a short couple composed of wires E and F, which are, in turn, connected at G. The wires E and F are not necessarily of the same materials as the wires B C. The arrangement is such that the electromotive force produced at the junction G opposes that at the junctions K and D. Fixed around the sheath A in the vicinity of the



junction G is a ring H of poor heat-conducting material—or a material of large capacity for heat. Should the junctions K, D and G be all at the same temperature, the electromotive force on the leads C and D is equal to the combined electromotive forces of the junctions D and E minus that of the junction G. When the whole device is being heated, the temperature of the junction G lags behind that of the junctions K and D, owing to the poor conductivity of the ring H; hence, the total electromotive force of the compound is higher in proportion to the lagging temperature of the junction G. On cooling, the reverse will take place.—*April 11th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Municipal and County Engineers.—Irish District meetings in Belfast and Dublin.

Radio Society of Great Britain.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Informal meeting of the Transmitter and Relay Section. Discussion on "The Design of Transmitting Valves." 6.30 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Lecture, "Radio Facts and Fancies," by Mr. E. Rawson. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Third Report of the Steam Nozzles Research Committee. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "The Stained Glass of York Minster," by the Very Rev. W. Foxley Norris. 9 p.m.

SATURDAY, MAY 17TH.

Institute of British Foundrymen: Lancashire Branch.—Visit to the works of Howard and Bullough, Limited, Accrington. 3.15 p.m.

Institution of Municipal and County Engineers.—Sessions House, Maidstone. South-Eastern District meeting. 11 a.m.

WEDNESDAY, MAY 21ST.

Institution of Welding Engineers.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Paper, "Power Supply for Electric Welding Operations," by Dr. J. H. Patterson. 8 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C.2. Trueman Wood lecture, "The Outlook in Chemistry," by Sir W. J. Pope, D.Sc., F.R.S. 8 p.m.

THURSDAY, MAY 22ND.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. "Atmospheric Interference in Wireless Telegraphy" (Lecture II.), by Dr. E. V. Appleton. 5.15 p.m.

FRIDAY, MAY 23RD.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Historical Aspects of Malaria," by Dr. Andrew Balfour. 9 p.m.

SATURDAY, MAY 24TH.

Institution of Municipal and County Engineers.—Southern District meeting at Abingdon. 10.30 a.m.

THURSDAY, MAY 29TH.

Royal Automobile Club.—The annual general meeting of the R.A.C. will be held at the Club on Thursday, May 29th, at 2.30 p.m.

THURSDAY TO SATURDAY, MAY 29TH TO 31ST.

Institute of Transport.—Congress at Bristol. For programme, see page 478.

MONDAY, JUNE 2ND.

Institution of Automobile Engineers.—Royal Automobile Club, Pall Mall, London, S.W. 1. Dinner to celebrate Colonel Crompton's eightieth birthday. 7.30 p.m.

TUESDAY TO FRIDAY, JUNE 3RD TO 6TH.

Empire Mining and Metallurgical Congress.—At the British Empire Exhibition, Wembley. For programme see page 508.

WEDNESDAY, JUNE 4TH.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, Westminster, London, S.W. 1. Fourteenth annual May Lecture on "Atoms and Isotopes," by Dr. F. W. Aston, F.R.S. 8 p.m.

WEDNESDAY AND THURSDAY, JUNE 18TH AND 19TH.

Newcomen Society.—Summer meeting at Shrewsbury.

LAUNCHES AND TRIAL TRIPS.

Camberwell, self-trimming collier; built by the Tyne Iron Shipbuilding Company, Limited, to the order of the South Metropolitan Gas Company, Limited; dimensions, 244ft. by 36ft. 6in. by 20ft. 6in.; 2450 tons deadweight. Engines, triple-expansion, 18in., 30in., and 49in. by 33in. stroke, pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company, Limited; trial trip, April 29th.

Martina, twin-screw tanker; built by Rotterdamsche Droogdok Maatschappij; dimensions, 305ft. long by 50ft. beam; 2698 gross tonnage. Engines, two triple-expansion; constructed by the builders; trial trip, May 1st.

Medomsley, steel screw steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of the Medomsley Steam Shipping Company, Limited; dimensions, 375ft. by 51ft. by 27ft.; 6500 tons deadweight. Engines, triple-expansion, surface condensing, 25in., 41in., 66in. by 45in. stroke, pressure 180 lb.; constructed by the builders; launch, May 1st.

Gallium, steel screw collier; built by the Blyth Shipbuilding and Dry Docks Company, Limited, to the order of A. Lemoine et Fils, of Rouen; dimensions, 271ft. by 37ft. 3in. beam. Engines, triple-expansion, 21in., 34in., 56in. by 36in. stroke; constructed by the North-Eastern Marine Engineering Company; launch, May 2nd.

Silverpine, single-screw motor ship; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Mount Steamship Company; dimensions, 400ft., 55ft. 3in. by 28ft. 8in.; 8400 tons deadweight. Engines, Naptune oil engines; constructed by the builders; launch, May 3rd.

CONTRACTS.

Highways Construction, Limited, Iddesleigh House, Caxton-street, London, is now surfacing the Sidcup–Wrotham arterial road with its clinker asphalt paving, the area being 200,000 square yards. It is also surfacing the Gravesend–Strood arterial road for the Kent County Council, an area of 95,000 square yards, and has further contracts in hand from the Ministry of Transport for surfacing sections of the London–Southend road, 67,000 square yards, the London–Tilbury road, over 120,000 square yards, and Eastern-avenue, Essex, 37,000 square yards.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are asked to state that the business of the late Major S. Utting will be carried on as usual at his former offices at 82, Victoria-street, S.W. 1.

We are asked to state that Mr. F. M. Jones, B.Sc., has joined the engineering sales staff of the Vickers-Spearing Boiler Company, Limited, 20 Kingsway, London, W.C. Mr. Jones was formerly on the contract department staff of the B.T.H. Company, Rugby, and recently with W. H. Allen, Sons and Co., Limited, Bedford.

We are informed that Mr. S. H. March, M.I. Mech. E., has joined the staff of Alfred Herbert, Limited, of Coventry. Mr. March was formerly director and general manager of the Churchill Machine Tool Company, Limited, of Broadheath, near Manchester, and also for many years manager for Chas. Churchill and Co., in Lancashire and Yorkshire.

Messrs. Dodd and Watson, of County Chambers, Corporation-street, Birmingham, inform us that they have been joined in partnership by Mr. John D. Watson, member of Council of the Institution of Civil Engineers, who has resigned his position of chief engineer to the Birmingham Tame and Rea District Drainage Board to devote his whole time to private practice.

The Union Petroleum Products Company, Limited, announces that it has changed its name to the Redline Motor Spirit Company, Limited. The sole reason for this change is that the company may be identified more closely in future with the brand of motor spirit which it is at present marketing. No alteration whatever has been made in the constitution, management or policy of the company.

Last year the proprietors of the *Colliery Guardian* offered prizes for practical suggestions tending to greater safety in haulage operations in coal mines. This competition resulted in useful suggestions being received from workmen in every one of the British coalfields. Encouraged by this success, the proprietors have decided to promote a second competition, in which prizes will be given for the best suggestions for preventing accidents due to falls of ground in mines.

Overhead Aluminium Conductors.—We omitted to state, with regard to the lecturette on "Aluminium Electrical Conductors for Overhead Power Transmission"—to which reference was made on page 507 of our issue of May 9th—that it was delivered by Mr. H. G. Williams before the Junior Institution of Engineers.

The Kelvin Dinner.—The Kelvin Dinner will take place on Friday, July 11th, at the Connaught Rooms, when the Right Hon. Earl Balfour, K.G., O.M., F.R.S., will take the chair. Members of the Institution of Civil Engineers desiring to attend this dinner are requested to communicate with Mr. D. N. Dunlop, honorary secretary of the Kelvin Centenary Committee, 61 and 62, Lincoln's Inn-fields, W.C. 2, from whom further particulars may be obtained

Norton and Gregory Engineering Scholarships, 1924.—The following scholarships, total value £450, offered for competition by Norton and Gregory, Limited, of Castle-lane, Buckingham-gate, London, S.W. 1, have now been awarded as follows:—Douglas James Thomas Haynes, Charterhouse School, Godalming: £80 per annum, tenable for three years at Cambridge University; John Phillip Berkin, Taunton School: £80 per annum, tenable for three years at Cambridge University; and Thomas Blench, Allan Glen's School, Glasgow: £20 per annum, tenable for three years at Glasgow University.

Junior Institution of Engineers.—The fortieth anniversary of the Junior Institution of Engineers was celebrated at a dinner at the Café Monico on Tuesday, May 6th. Sir J. Fortescue Flannery, Bart., President of the Institution, was in the chair. There were also present Sir T. O. Callender, as a guest of the President, and Sir Archibald Denny and Captain H. Riall Sankey, Past-Presidents. Sir Archibald Denny, proposing the toast of the Institution, emphasized the value of taking part in all the Institution's activities, especially the visits. One of his most profitable inventions was directly due to an idea which originated during a visit to a works not in his line at all. Mr. W. J. Tennant proposed "Marine Engineers," to which Sir Fortescue Flannery replied. He impressed on men who desired to attain success that they must have a speciality. To be of the best service to engineering, an engineer had to give special study to a special section.